Safety Laser Scanner

UAM-02LP

User's Manual

Tapeswitch®

FOR SALES & SERVICE
CALL 1-800-234-8273

HOKUYO AUTOMATIC CO.,LTD.

Manual No.MRS0013A

Table of contents

1. Introduction 1
  1.1 About this document 1
  1.2 Applicable product 1
  1.3 Abbreviations 1
  1.4 Special markings and symbols 1
  1.5 Applicable directives and standards 2
  1.6 Safety precautions 2
    1.6.1 General 2
    1.6.2 Working environment 3
    1.6.3 Installation 3
    1.6.4 Wiring 4
    1.6.5 Configuration 4
    1.6.6 Test and maintenance 4
  1.7 Package contents 5
  1.8 Options 6
    1.8.1 L-shape mounting bracket (Model: UAM-BK01) 6
    1.8.2 Vertical mounting bracket (Model: UAM-BK02) 6
    1.8.3 Connector cable 6
    1.8.4 USB cable (Model: UAM-USB5) 7
    1.8.5 Configurator CD (Model: UAM-CD02) 7
2. Specification 8
  2.1 UAM-02LP 8
  2.2 UAM components 10
3. Product overview 11
  3.1 UAM-02LP features 11
  3.2 Operation principle 12
  3.3 Scanning area 13
    3.3.1 Protection zone 13
    3.3.2 Warning zone 14
  3.4 Area switching 15
  3.5 OSSD 16
    3.5.1 Self-diagnostic function of OSSD 16
    3.5.2 OSSD signal in different system state 17
      3.5.2.1 Lockout state 17
    3.5.3 OSSD Interlock 18
      3.5.3.1 Automatic restart (Interlock disable) 18
      3.5.3.2 Manual restart (Interlock enabled) 18
      3.5.3.3 Start interlock 19
  3.6 External device monitoring (EDM) 20
  3.7 Muting 21
    3.7.1 Muting start condition 21
    3.7.2 Muting stop condition 22
    3.7.3 Muting override function 22
  3.8 Reference boundary monitor 23
    3.8.1 Area protection 23
    3.8.2 Access protection 23

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.9 Area sequence 24
3.10 Response time 25
3.11 Other Output 25
3.11.1 Warning output (WARNING1) 25
3.11.2 Warning output (WARNING2) 25
3.11.3 Error output (ERR) 25
3.11.4 Muting output (MUT_OUT) 25
3.11.5 Ready output (READY) 25
3.11.6 Reset Request (RES_REQ) 25
3.12 Information indicator 26
3.12.1 LED 26
3.12.2 7-segment display 26
4. UAM application examples 27
4.1 Area protection (Horizontal application - Stationary) 27
4.2 Area protection (Horizontal application - Mobile) 30
4.3 Access protection (Vertical application - whole-body detection) 33
4.4 Access protection (Vertical application - body parts detection) 36
5. Installation 38
5.1 Light interference 38
5.2 Mutual interference 39
5.3 High reflective background 40
5.4 Limited detection capability zone 41
6. Wiring 42
6.1 Precautions 42
6.2 Power supply 42
6.3 Wire colour and coding 42
6.4 Wiring example 43
6.5 Input/Output circuit 44
6.5.1 OSSD output circuit 44
6.5.2 Other Output circuit 44
6.5.3 Input circuit 44
7. UAM Configurator application software 45
7.1 About UAM Configurator Application Software 45
7.2 System requirements 45
7.3 UAM driver installation 46
7.4 UAM Configurator application software installation 46
7.5 Starting the UAM Configurator application software 47
7.6 Uninstall 47
7.7 Startup main window 48
7.7.1 Create new configuration 49
7.7.2 Open configuration file 49
7.7.3 Read settings from device 50
7.8 Configurator components 50
7.9 Menu bar 51
7.9.1 File 51
7.9.2 Graphics 51
7.9.3 Connection 52

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.9.4 Mode 52
7.9.5 Option 53
7.9.6 Language 54
7.9.7 Help 54
7.10 Toolbar 55
7.11 Subpanel 56
7.11.1 Configuration tab 56
7.11.1.1 General 56
7.11.1.2 Function 56
7.11.1.3 Area configuration 58
7.11.1.4 Area configuration tab 58
7.11.1.5 Displayed zone 59
7.11.1.6 Drawing assistance tool 60
7.11.1.7 Write 60
7.11.2 Monitor tab 61
7.11.3 Report tab 62
7.12 Connecting the UAM with PC 64
7.13 Password 65
7.13.1 Changing password 65
7.13.2 Reclaim forgotten password 65
7.14 Configuration mode 66
7.15 Function configuration 67
7.16 Zone configuration 68
7.16.1 Zone configuration by drawing tools 69
7.16.2 Zone configuration by numeric input 70
7.16.2.1 Single point manipulation 71
7.16.2.2 Multipoint manipulation 73
7.16.3 Zone configuration by Teaching function 74
7.16.4 Reference monitoring configuration 75
7.16.5 Muting configuration 77
7.16.6 Writing configurations into UAM 79
7.17 Save Project 81
7.18 Read settings from device 82
7.19 Open Project 83
7.20 Data logging 83
8. Inspection and maintenance 85
8.1 Pre-operation inspection 86
8.2 Operation inspection 87
8.3 Daily inspection 88
8.4 Periodical inspection 89
8.5 Cleaning the optical window 90
9. Troubleshooting 91
10. Dimensions 93
10.1 UAM-02LP-T302 93
10.2 L-shape mounting bracket 94
10.3 Vertical mounting bracket 95
11. Revision history 96
12. Representative contacts 97

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

1. Introduction

This user's manual of UAM is designed with the purpose of providing guidelines and instructions for the technical personnel of the machine manufacturer or the machine operator while operating the UAM.

1.1 About this document

UAM's features, technical specification, installation and handling method and safety precautions are described in this document.

- Please read carefully and understand this document before installation, operation and maintenance.
- The Operator of the UAM should have a copy of this document at an easy-access place for quick reference.
- Any modification on the UAM is prohibited. Such modification will affect the UAM performance and hence changes in UAM's detection capability. This could lead to critical injury and death.
- Any modification made to the UAM will void the warranty.

1.2 Applicable product

This manual is written for and applies to the following sensor model:

- UAM-02LP-T302

1.3 Abbreviations

The list below shows the abbreviations used in this document.

Abbreviation	Meaning
AGV	Automated guided vehicle
AOPDDR	Active opto-electronic protective device responsive to diffuse reflection
EDM	External device monitoring
OSSD	Output signal switching device
MSCE	Machine secondary control element

1.4 Special markings & symbols

Special markings and symbols are used in this document to alert the reader especially to safety-related issues. Follow strictly the instructions marked by these special markings and symbols to ensure safety during the operation.

Mark	Meaning
Danger	Procedures that could lead to dangerous situation, critical injury or death if not carried out properly.
Caution	Procedures that could lead to dangerous situation, serious injury or physical damage if not properly carried out.
Note	Points that should be considered for proper operation

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

1.5 Applicable directives and standards

UAM (UAM-02LP-T302) is certified by TÜV SÜD Product Service GmbH as a safety sensor defined in EU Machine Directive (2006/42/EC), which complies with the directives and standard as listed below:

Directives/Standard	Details		
Directives	Europe	EMC Directives	
		RoHS Directives	
EC directives	Europe	EC Machine Directive 2006/42/EC	
		EC EMC Directive 2004/108/EC	
Harmonized standards	Europe	ISO13849-1:2006	Safety of machinery Category 3, PL d
		IEC61508 Part1-7:2010 IEC62061:2005	Functional Safety SIL2
		IEC61496-1:2007	Application Standard Type 3
		IEC61496-3:2008	Application Standard Type 3
		IEC60825-1:2008	Safety of laser products Class 1

1.6 Safety precautions

Please read the following guidelines for correct use of the UAM. Proper handling and usage ensure the UAM to operate accordingly:

1.6.1 General

- UAM is an AOPDDR that detects obstacles within the configured protection zone by detecting diffused optical radiation. Optical radiations are generated and emitted into the configured protection zone. The optical radiations are then rotated by a rotating motor covering the protection zone. The optical radiations are diffused and reflected back towards the receiving unit of the UAM.
- Pre-operation tests must be performed in order to verify the functionality and the performance of the UAM.
- It is necessary to operate the UAM within the specifications described in this user's manual and perform required maintenance to prevent deterioration of UAM's detection capability.
- Do not modify or dissemble the UAM to ensure housing IP rating is maintained
- Operator is referred to a person who is responsible and qualified to operate the UAM. Operator should have attended appropriate safety-related training and could operate the UAM correctly.
- A person-in-charge must be assigned and have trained the operator about the correct use of UAM.
- The person-in-charge must understand this manual and is responsible to ensure proper working environment for the UAM.
- The person-in-charge is responsible for the compliance with the local safety requirements, standards, rules and regulations, laws of respective nations, states or districts when the UAM is used in a safety-related system.
- Operator should prepare test pieces for detection capability verification test. The size of the test piece should be equivalent to the minimum detectable width of the object.
- Maximum level of homogeneous pollution for UAM is 30%. Warning signal will be displayed if the pollution exceeded the stated limit. However, operator should always keep the optical window in clean condition.
- During decommission of the UAM, protective measures must be taken to ensure safety on the protected area. Protective materials such as guards or light curtain should be used to prevent any passage into the hazardous area.
- UAM should be disposed as industrial waste or in accordance with the local disposal directives.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

1.6.2 Working environment

- Please ensure the UAM's working environment is within the stated specification (temperature, humidity, vibration, light interference etc.).
- Do not use or mount the UAM near any device that could generate strong radio waves as the radio waves could interfere the operation of the UAM.
- Do not use or mount the UAM in an environment that is dusty, smoky or in presence of corrosive substances. Detection capability of UAM will drop under such working environments.
- Before resetting the interlock of the UAM, operator must ensure the surrounding is safe especially in the protection zone.

1.6.3 Installation

- Install the UAM on a firm surface or structures to avoid displacement of the sensor.
- The UAM should be firmly mounted using screws. Shock and vibration should not loosen the mounting. UAM will not operate properly if the protection zone is different from the intended area due to the displacement. Recommended torque for screws is 3 N.m.
- Safety distance must be determined before installing UAM. User must ensure the functionality of the UAM after installation by placing a test piece in all the protection zone (Refer to Chapter 4 for details on safety distance for various applications).
- During the installation of the UAM, protective materials such as guards or light curtain should be used to prevent any passage into the hazardous area.
- Reset switch used for Restart Interlock function should be mounted at a location away from the protection zone.
- Mutual interference could occur when identical UAMs are mounted at the same detection plane. Refer to Chapter 5 for countermeasures to avoid mutual interference.
- UAM should be mounted at a location which has sufficient space for maintenance.
- Do not add any protective materials such as glass, transparent cover etc in front of the optical window. This would lead to loss of detection capability of the UAM.
- UAM will not operate without an initial configuration.
- Minimum detectable width varies with the distance. Refer Chapter 2 for details.
- Increasing the response time of the OSSD will increase availability of the UAM. However this will reduce the detection capability towards moving objects. User must perform risk assessment before using this function.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

1.6.4 Wiring

- Switch OFF all the power supply during wiring.
- If the source of the power supply is taken from a converter, please ensure the power supply fulfills the following requirements:
  a) A rated output voltage of 24V DC ± 10%(SELV circuit, Overvoltage Category II)
  b) Reinforced insulation or double insulation for the primary and secondary circuit
  c) Holding time of the output should be above 20ms
  d) The power supply must comply with the requirements of electrical safety and electromagnetic compatibility (EMC) regulations of the respective country, states and district.
- All the input/output signal cables should be installed away from machines power lines and high-voltage cables.
- Use OSSD of the UAM to control safety-related machine/system. Do not use Warning signals to control safety-related machine as these are non-safety signals.
- Do not use cables other than supplied by the manufacturer (Chapter 6).
- Do not use any intermediate connection between OSSD signals and safety-related machines or systems. OSSD signals should be connected directly to the safety related machines or systems.

1.6.5 Configuration

- Configuration of safety functions are password protected. Only authorized personnel or operator with password are allowed for configuration.
- Pre-operation test must be performed to verify the configurations before operating the UAM.
- Changes made during the configuration must be recorded. Operator can use the report generating function in the UAM Configurator (Chapter 7).

1.6.6 Test and maintenance

- User must perform the following tests and maintenance by referring to the checklists in this manual (Chapter 8).
  a) Pre-operation inspection
  b) Operation inspection
  c) Daily inspection
  d) Periodical inspection

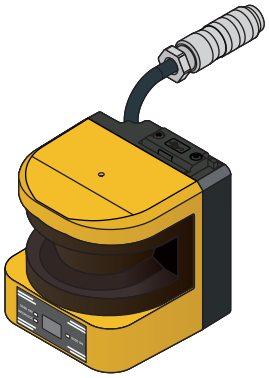
  The checklist establishes the basic guidelines while performing the test and maintenance. User must perform additional test and maintenance which are necessary for the application.
- Stop the machine and stop using the UAM if faults are detected during these tests.
- Clean the optical window when it gets contaminated, if the optical window replacement is needed, please contact the nearest distributor or sales representative.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

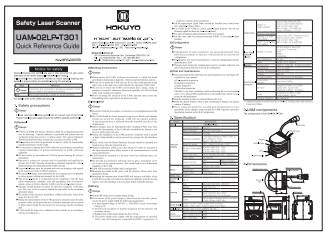
1.7 Package contents

Each purchase consists of the following:

a) UAM ×1



b) Quick reference ×1



c) Configurator CD ×1

The CD consists of the following files:

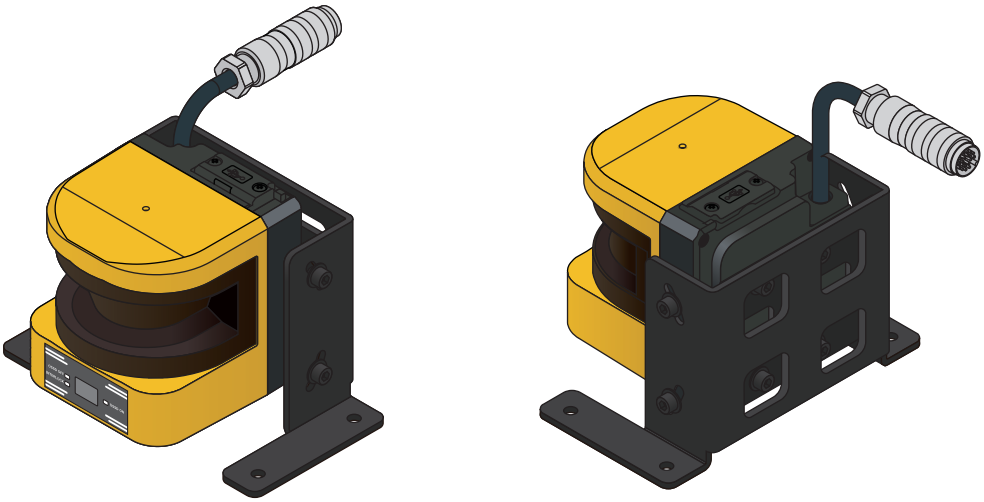
- setup.exe
- UAMConfiguratorSetup.msi
- URG_USB_Driver.inf
- UAM_Manual_MRS0013A_jp.pdf
- UAM_Manual_MRS0013A_en.pdf
- .NET framework related files

 All Rights Reserved

1.8 Options

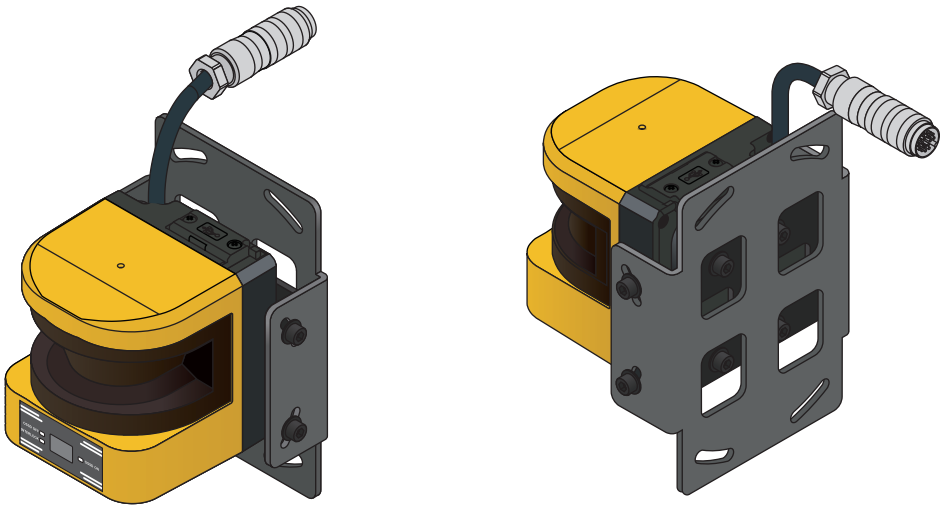
1.8.1 L-shape mounting bracket (Model: UAM-BK01)

This bracket can be used to change the horizontal angle alignment of the UAM during installation. This is useful especially in preventing mutual interference when two or more UAMs are used.



1.8.2 Vertical mounting bracket (Model: UAM-BK02)

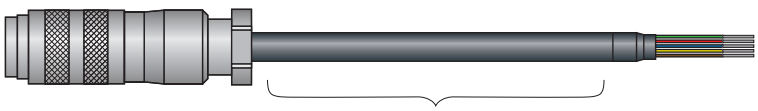
This bracket can be used to change the vertical and horizontal angle alignment of the UAM during installation. This is useful especially in preventing mutual interference when two or more UAMs are used.



1.8.3 Connector cable

Cable with different lengths is available.

Product code	Model number	Length (m)
UZ00036	UAM-C002	2
UZ00034	UAM-C005	5
UZ00032	UAM-C010	10
UZ00035	UAM-C020	20



2 ／ 5 ／ 10 ／ 20m

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

1.8.4 USB cable (Model: UAM-USB5)

This is a cable used to connect UAM and PC. Length of the USB cable is 5 m.

1.8.5 Configurator CD (Model: UAM-CD02)

This CD consists of the configuration software, UAM's driver and other related documents.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

2. Specification

2.1 UAM-02LP

Subject	Specifications		
Model	UAM-02LP-T302		
Detection property	Protection Range	Max.2.0m	
	Warning Range	Max.10.0m (Non-safety)	
	Distance tolerance*[1]	+100mm	
	Detection capability	From Black-Reflector Sheet(1.8%) to Retro-Reflector Sheet Speed: 1.6m/s max.	
	Detection angle	190°	
	Minimum Detectable Width	ϕ30mm (Max. Dist.: 1.0m) ϕ50mm (Max. Dist.: 1.5m) ϕ70mm (Max. Dist.: 2.0m)	
	Scan Frequency	30ms (Rotational Speed 2000rpm)	
	Area pattern	16 patterns	
	Response time	OFF	60 to 510ms
		ON	270 to 510ms
Optics	Element	Pulsed Laser Diode	
	Wavelength	905nm	
	Safety Class	Laser Class 1	
Safety Type	Type 3 (IEC 61496-1, IEC 61496-3)		
Functional Safety	SIL 2 (Type B, HFT=1) (IEC61508)		
PFH_d	7.5×10^{-8} (T1=20year)		
Housing	Size	90.0mm (W), 99.8mm (D), 97.0mm (H)	
	Weight	Approx. 1.0kg	
	Protection	IP65	
	Material	Body Aluminum / Optical Window: Polycarbonate	
	Cable	Flying cable and water proof connector /Cable 300mm /M16-19p	
Power Supply	DC 24V ± 10% : Power supply from converter DC 24V -30% /+20% : Power supply from battery		
Cable length	Length 20 m AWG 22, 26, 28		
Power consumption	Normal (without load)	11W	
	Max. (without load)	19W	
	Max. (with load)	58W	

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Subject	Specifications	
Output types	OSSD1/2 (Safety-related)	Output type (High side SW)
		Output current (Max: 500 mA)
		Leak current (Max: 1mA)
		Wire (Length: 20m AWG 26)
		Load (L/R=25ms C=1μF)
	WARNING 1 (Non-safety)	Output type (PNP Transistor output)
		Output current (Max: 100mA)
		Leak current (Max: 1mA)
		Wire (Length: 20m AWG 28)
	WARNING2 / ERR / MUT_OUT (Non-safety)	Output type (PNP Transistor output)
		Output current (Max: 100mA)
		Leak current (Max: 1mA)
		Wire (Length: 20m AWG 28)
	READY or RES_REQ (Non-safety)	Output type (PNP Transistor output)
		Output current (Max: 100mA)
		Leak current (Max: 1mA)
		Wire (Length: 20m AWG 28)
Input	Number of inputs	16 area switching (4 inputs x 2 channels) EDM/RESET/MUTING1/MUTING2/OVERRIDE (1 input x 1 channel)
	Input Impedance	4.7 kΩ
	Cable	Length 20m AWG 28
Interface	Configuration	USB2.0 (USB mini B type connector)
Environmental resistance	Temperature	−10 to +55℃
	Storage Temperature	−25 to +70℃
	Humidity	95% RH
	Storage Humidity	No freezing and condensation
	Surrounding Intensity*2	Less than 3000lx
	Vibration	Frequency range: 10 to 55Hz Sweep rate: 1octave/min Amplitude: 0.35mm ± 0.05mm
	Bump	Acceleration: 98m/s^2(10G) Pulse duration: 16ms
	Outdoor Operation	Not permitted

*1. Additional distance of 200mm is needed when the UAM is working under high reflective background.

*2. When the light sources located at ≥5° from the detection plane of UAM.

 All Rights Reserved

2.2 UAM components

Figure 2-1 shows the components of the UAM-02LP.

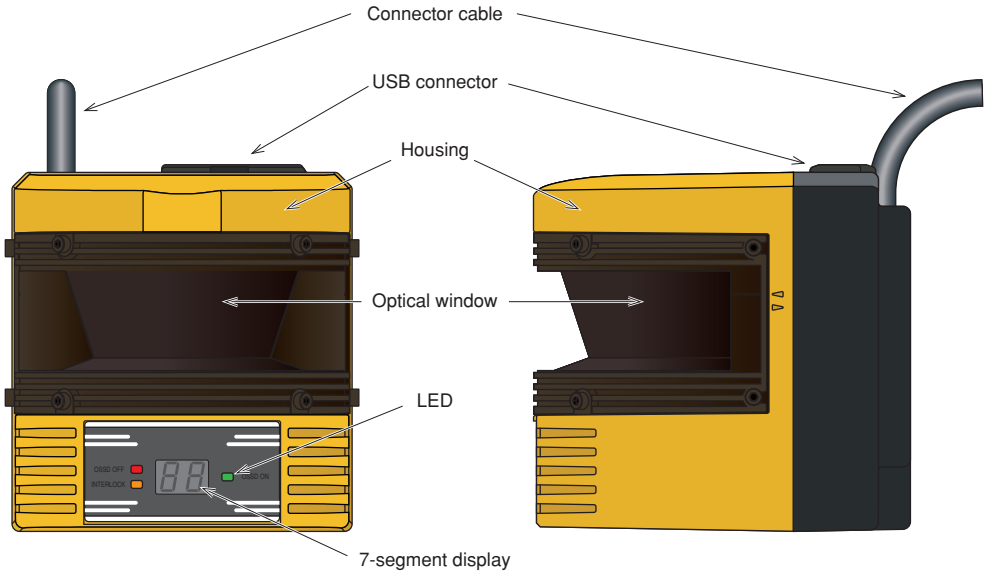


Figure 2-1. UAM-02LP components

Figure 2-2 shows the scanning range and detection zone origin of UAM. Figure 2-3 shows the detection plane of the UAM.

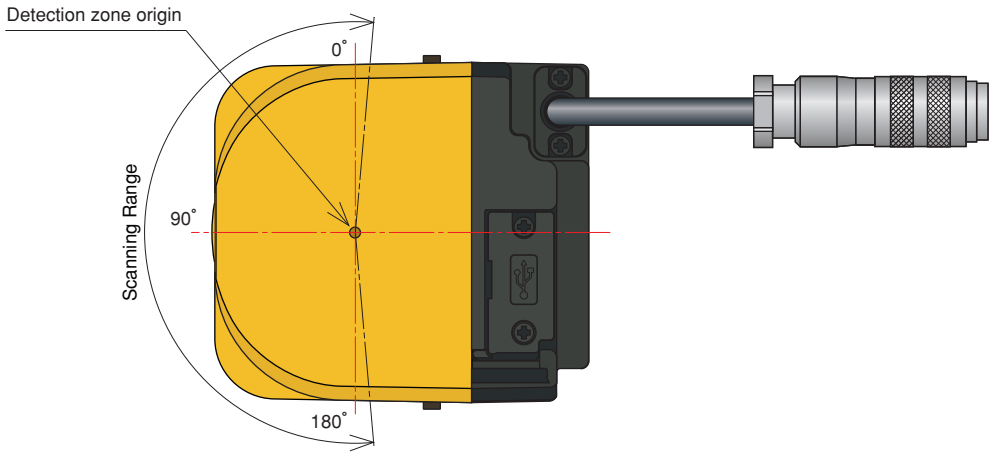


Figure 2-2. Scanning range and protection zone origin (Top view)

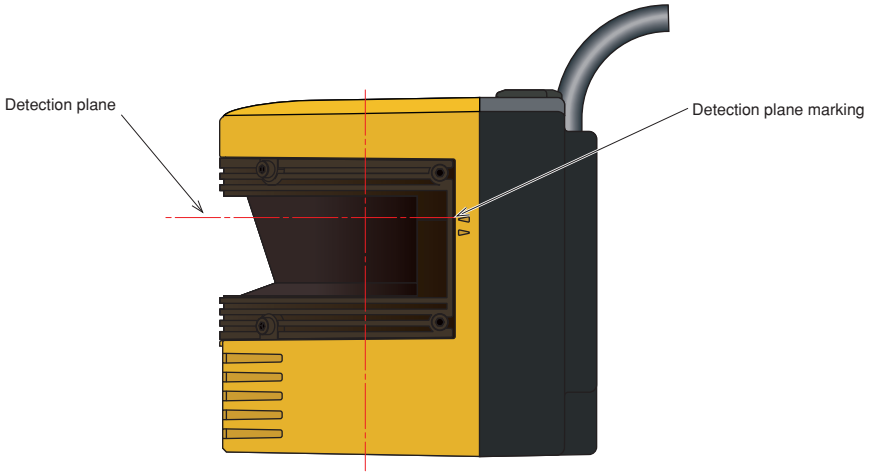


Figure 2-3. Detection plane of UAM (Side view)

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3. Product overview

This chapter describes the UAM features.

3.1 UAM-02LP features

- Protection range of 2.0m
- Warning range of 10.0m
- Detection angle of 190°
- 16 set of areas (Configurable)
- LEDs indicating UAM's status
- 7-segment LED display
- Easy configuration using PC installed with UAM Configurator application software
- Minimum response time of 60ms (Configurable)
- Interlock (Configurable)
- EDM (Configurable)
- Muting (Configurable)
- Muting Override
- Reference boundary monitor (Configurable)
- Contamination-detecting device for optical window

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.2 Operation principle

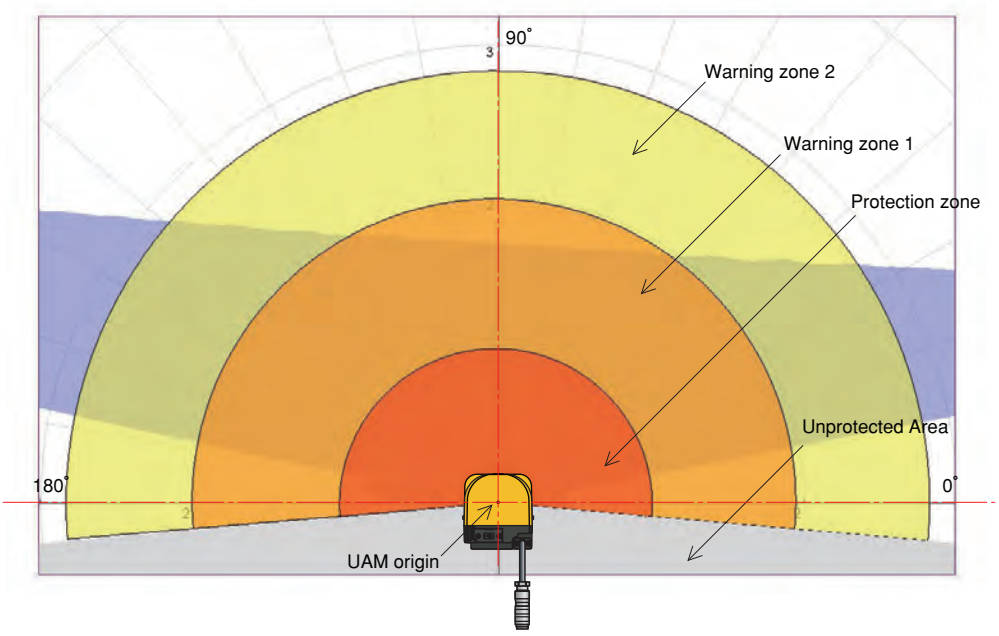


Figure 3-1. Scanning range

Figure 3-1 shows the scanning range of the UAM. Protection zone, warning zones are configured using the UAM Configurator application software. Any objects entering the configured protection zone will lead to the change of OSSD signal from ON-state to OFF-state. Similarly, an object detected in the warning zones will lead to the warning signal change to OFF-state. Distance is measured using the Time of Flight (TOF) principle. Pulsed laser beam is radiated into the scanning range of 190° while the motor start rotating. These pulsed laser beams are reflected back by any object inside the scanning range. Duration of the reflected pulsed laser beam is taken for distance calculation as shown below:

$$L = \frac{1}{2} \times C \times T$$

Where L =Distance of the object

C = Light speed

T = Time difference

The working principle of the TOF is shown in the schematic diagram (Figure 3-2) below:

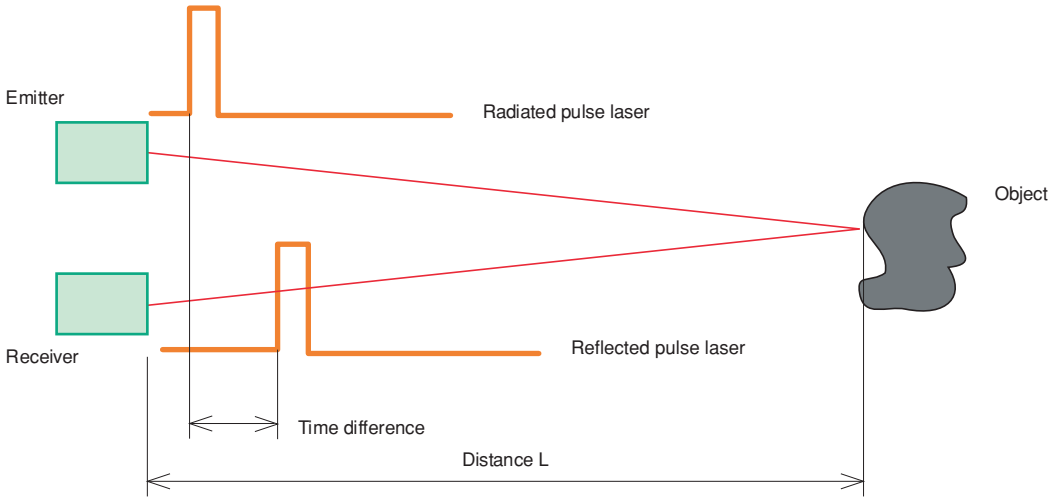


Figure 3-2. TOF principle

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.3 Scanning area

Scanning area of the UAM consists of protection zone and two warning zones. Protection zone is safety-critical and directly connected to OSSD signal. When obstacle is detected in this protection zone, the UAM will switch the OSSD to OFF-state which should trigger a switch to stop a machine or vehicle. For mobile applications, the OSSD signal should be used as emergency stop signal.

3.3.1 Protection zone

Figure 3-3 and 3-4 show an example of protection zone configured using manual mode and teaching mode respectively using the UAM Configurator application software (Chapter 7). Operator can configure these zones accordingly to ensure the hazardous area is completely protected.

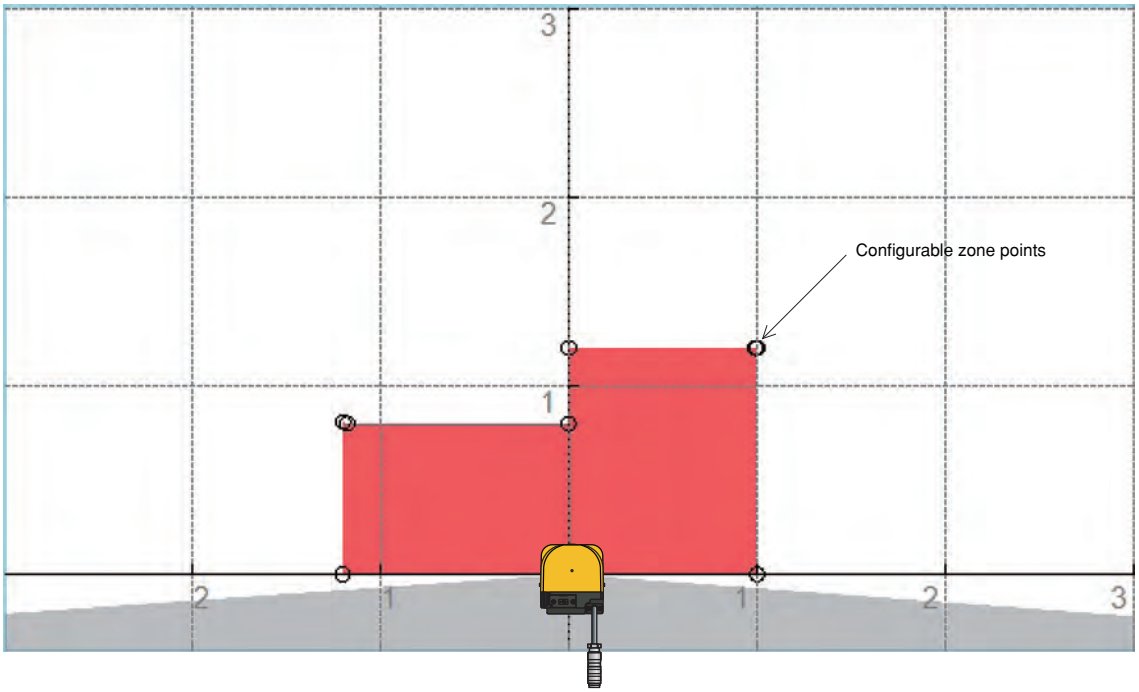


Figure 3-3. Protection zone manual configuration

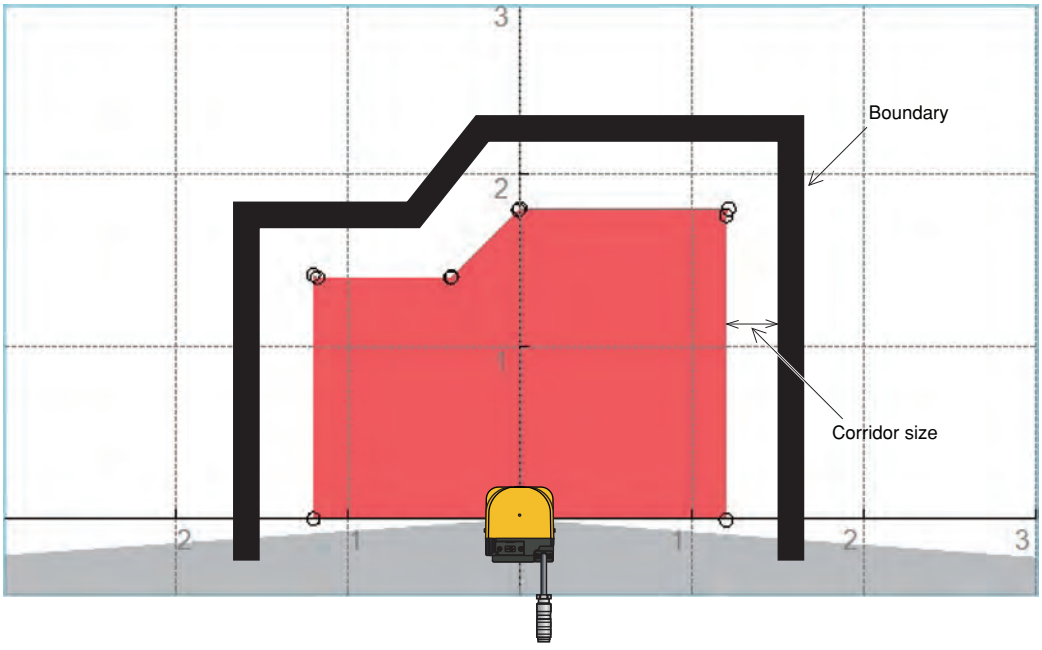


Figure 3-4. Protection zone configuration using teaching function

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- Operator must verify the configured zones before operation.
- Configured protection zone must have minimum Safety distance.
- Detectable minimum width varies with distance.
- Tolerance zone must be included when configuring the protection area.

Caution

- Verify the detection capability with the actual object before operation.

3.3.2 Warning zone

Warning zones are non-safety and are connected to WA1 and WA2 outputs. Object detected in these zones switch the warning signal from ON-state to OFF-state. The warning signal can be used as an alert signal for humans or objects to avoid from approaching the protection zone. For mobile applications, warning zones can be used to reduce the speed of the vehicle to avoid collision. Figure 3-5 shows the warning zones.

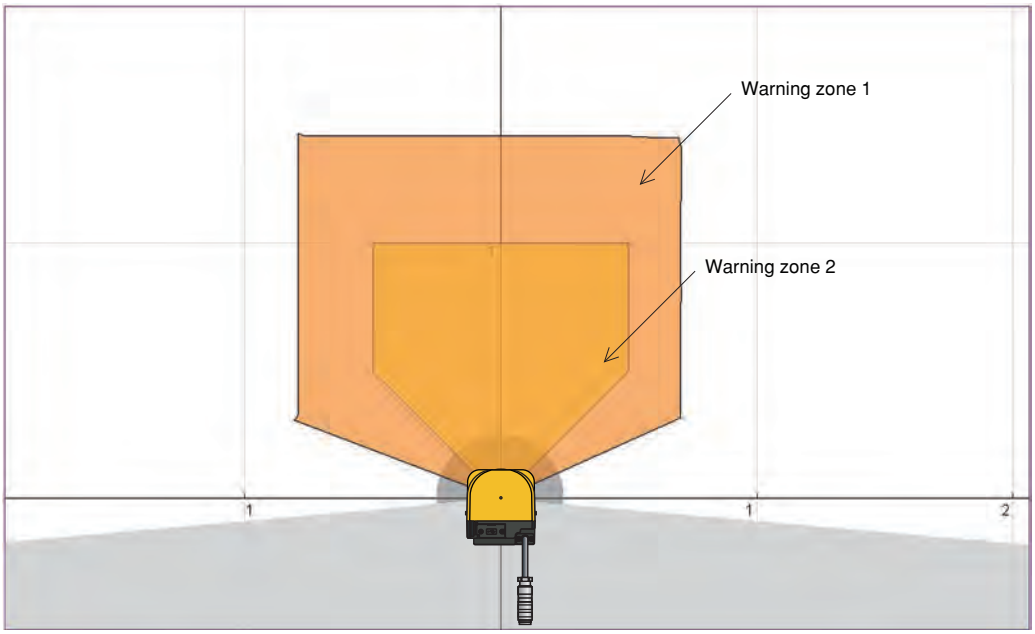


Figure 3-5. Warning zones

Danger

- Output signal of Warning zone is a non-safety signal.
- Warning zone output signals must not be used to control any machine or vehicle for safety-related purposes.

Caution

- Warning signal is a non-safety signal.
- Warning signal 1 & 2 and OSSD signal is not inter-related.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.4 Area switching

This is a function to switch the area pattern. UAM can store up to 16 areas. Each area consists of protection zone, warning zone 1 and warning zone 2. Switching the area requires external input signals. Table 3-1 below shows the combination of input signal to switch area. Area-in-use is displayed by the 7-segment LED of the UAM is described in Chapter 3.11 The area switching time is configurable (Refer to chapter 7.11.1.2 for configuration).

Table 3-1. Input combination for area switching

Area Pattern	IN_A	IN_B	IN_C	IN_D	IN_$\bar{A}$	IN_$\bar{B}$	IN_$\bar{C}$	IN_$\bar{D}$
1	ON	ON	ON	ON	OFF	OFF	OFF	OFF
2	OFF	ON	ON	ON	ON	OFF	OFF	OFF
3	ON	OFF	ON	ON	OFF	ON	OFF	OFF
4	OFF	OFF	ON	ON	ON	ON	OFF	OFF
5	ON	ON	OFF	ON	OFF	OFF	ON	OFF
6	OFF	ON	OFF	ON	ON	OFF	ON	OFF
7	ON	OFF	OFF	ON	OFF	ON	ON	OFF
8	OFF	OFF	OFF	ON	ON	ON	ON	OFF
9	ON	ON	ON	OFF	OFF	OFF	OFF	ON
10	OFF	ON	ON	OFF	ON	OFF	OFF	ON
11	ON	OFF	ON	OFF	OFF	ON	OFF	ON
12	OFF	OFF	ON	OFF	ON	ON	OFF	ON
13	ON	ON	OFF	OFF	OFF	OFF	ON	ON
14	OFF	ON	OFF	OFF	ON	OFF	ON	ON
15	ON	OFF	OFF	OFF	OFF	ON	ON	ON
16	OFF	OFF	OFF	OFF	ON	ON	ON	ON

 All Rights Reserved

3.5 OSSD

OSSD is a safety-related signal. When a human or an object is detected in the protection zone, the OSSD signal will switch from ON-state to OFF-state. This OSSD will also be switched to OFF-state when error is detected by self-diagnostic function. The OSSD signal has self-diagnosis function which tests the signal periodically to detect any malfunction.

Danger

- OSSD is a safety-related signal and should be connected directly to the relay or device that switches the machine or vehicle under control.
- Sufficient time for the machine or vehicle to stop must be allocated when configuring the response time of OSSD.
- User must verify the configuration before actual operation.

Note

- During OSSD ON-state, the signal is at 24V, during OSSD OFF-state, the signal is at 0V.

3.5.1 Self-diagnostic function of OSSD

Self-diagnostic function of the OSSD detects any abnormalities in the output circuit by switching OFF the OSSD 1 and OSSD 2 at an interval less than 300μs. Therefore, safety-relay or power converter used must not react to this diagnostic function. Figure 3-6 below shows the timing chart of the self-diagnostic function of OSSD.

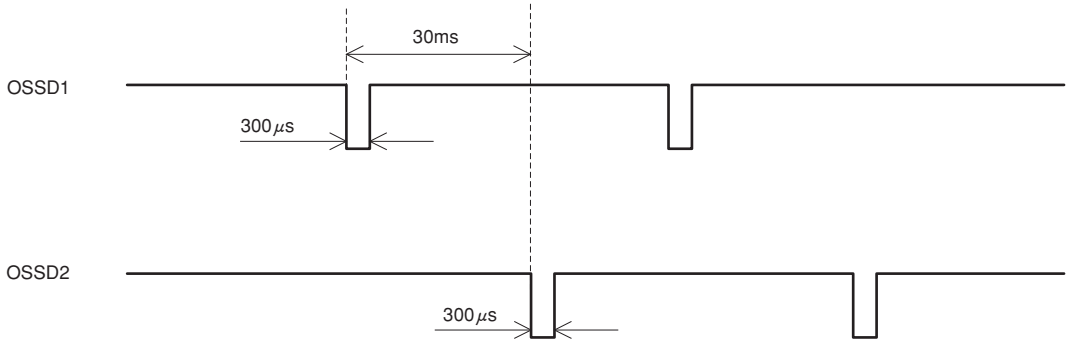


Figure 3-6. Timing chart of the OSSD's self-diagnostic function

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.5.2 OSSD signal in different system state

OSSD signal switches to OFF-state (0V) when protection zone is penetrated or error is detected by self-diagnostic function. By observing READY and ERR signals together with the OSSD signal, operator can understand the UAM state. Table 3-2 below shows the relationship between OSSD signal, READY signal and ERR signal in both operation state and initial state:

Table 3-2 Relation between OSSD, READY and ERR output signal

Item / State	Self-diagnostic	Penetration	Interlock configuration	Signal		
				OSSD	READY*2	ERR*3
Start-up	OK	—	—	OFF	OFF	OFF
	FAIL	—	—	OFF	OFF	OFF
Operation	OK	YES	Disable	OFF	ON	ON
			Enable	OFF	OFF	ON
		NO	Disable	ON	ON	ON
			Enable	OFF/ON*4	ON/OFF*4	ON
	FAIL*1	YES	Disable	OFF	ON	OFF
			Enable	OFF	OFF	OFF
		NO	Disable	OFF	ON	OFF
			Enable	OFF	OFF	OFF
Lockout	FAIL	—	Disable	OFF	OFF	OFF
		—	Enable	OFF	OFF	OFF

*1: UAM switch to lockout state when failure occurs during the self-diagnostic routines.

*2: When READY signal is configured. If interlock is configured, READY signal is replaced by RES_REQ.

*3: When ERR signal is configured.

*4: When Start/Restart mode is configured to Manual/Manual, OSSD is OFF, READY is ON. When configured to Manual/Automatic, OSSD is ON, READY is OFF.

3.5.2.1 Lockout state

When error is detected by the self-diagnostic function and cannot perform normal operation, UAM will switch to lockout state. At the lockout state, both OSSDs, WARNING1, WARNING2 and ERR will switch to OFF-state. After clearing the error, UAM can be reset by restoring the power and this will clear the UAM from lockout state. Table 3-3 below shows the ERR output in correspondence to OSSD OFF-state.

Table 3-3 Relation between OSSD output and ERR output

Cause	OSSD	ERR
Obstacle detection	OFF	ON
Device error	OFF	OFF

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.5.3 OSSD Interlock

Interlock is a function preventing automatic restart of the OSSD signal switching from OFF-state to ON-state. Interlocks functions are configurable using the UAM Configurator application software.

3.5.3.1 Automatic restart (Interlock disable)

UAM will operate with automatic restart mode when the interlock function is disabled or only start interlock function is enabled. When the obstacle detected in the protection zone is removed, OSSD signal switches from OFF-state to ON-state automatically.

Figure 3-7 below shows the timing chart of the automatic restart with OFF delay and ON delay configured. "a" and "b" are the OFF delay and ON delay respectively. However, if the UAM is in lockout state, the OSSD will remain in OFF-state even the interlock function is disabled.

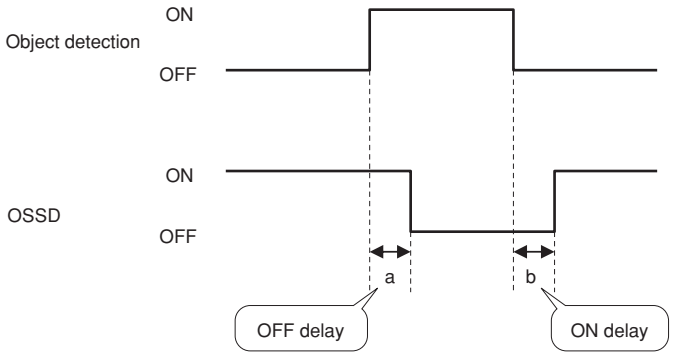


Figure 3-7. Timing chart of automatic restart

Caution

- Only use this function in applications where automatic restart does not affect the safety requirements.
- When delay function is configured, make sure that the delay duration is sufficient for the machine or vehicle to stop.

3.5.3.2 Manual restart (Interlock enabled)

UAM operates in restart interlock restart interlock is set to manual mode. The OSSD signal switches from ON-state to OFF-state if the UAM detects any obstacle within the protection zone or detected any system error. In this mode, even the detected obstacles or system error is cleared, the OSSD signal will remain in OFF-state. An external reset input signal is required to clear the interlock allowing the UAM to resumes to normal operation.

UAM will only resume to normal operation when there is a reset signal (RESET). The duration of reset signal should be minimum 0.5s. Figure 3-8 shows the timing chart of the manual restart. If the reset delay, "c" is configured, the OSSD signal will only switch to ON-state after the configured delay time is achieved. However, if the OFF-state of the OSSD is caused by the internal fault, the OSSD will remain in OFF-state regardless of interlock setting. Reset delay is configurable in the range of 1s to 6s.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

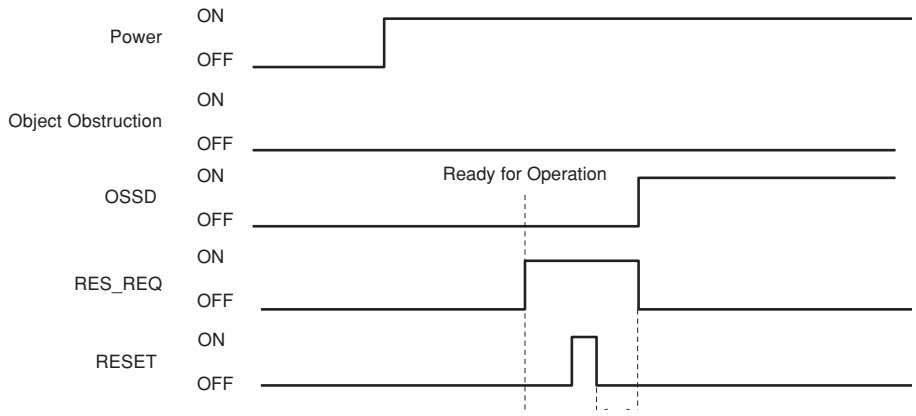


Figure 3-8. Timing chart of manual restart

Danger

- Operator must verify that the detected obstacle is safely removed before resetting the UAM.
- If the Restart Interlock function is used to restart the machine, the reset switch must be mounted at a location that is away from the protection area.
- Failing to comply with the above could lead to critical injury or death.

Note

- After the obstacle being removed from the protection area, if the OSSD remained in OFF-state, check the error code and the suggested solution (Chapter 9).
- Duration of reset input should not exceed 5s, otherwise it will be detected as hardware malfunction (signal-stuck at high).

3.5.3.3 Start interlock

Start interlock is a function to keep OSSD in OFF-state during the start-up until an external reset input is supplied. The RES_REQ is switched to ON-state after the UAM completes the initial routines and ready to accept the RESET input. When RESET input is supplied, the OSSD goes to ON-state provided no object is detected in the protection zone. The duration of the reset input must be 0.5 s and above. Figure 3-9 shows the sequence of start interlock.

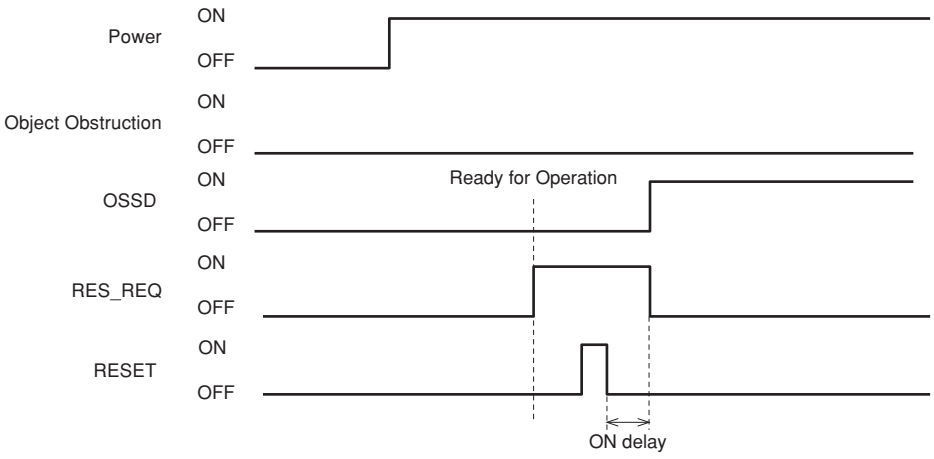


Figure 3-9. Start interlock sequence

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.6 External device monitoring (EDM)

EDM is a function that monitors the state of the input signal from the controlled machine or vehicle. EDM is configured using the UAM Configurator application software. When EDM is configured, any fault detected in EDM signal will cause the OSSD signal switched to OFF-state. EDM signal is always the inverse of the OSSD signal. EDM input signal ON/OFF delay is configurable. When the EDM function is not used, should not be connected. Figure 3-10 below shows the circuit of EDM. Figure 3-11 below shows the timing chart of the EDM and OSSD signal.

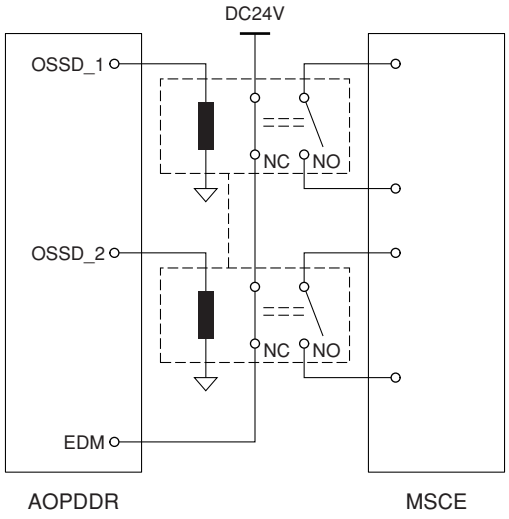


Figure 3-10. EDM circuit

Note

- EDM cable should not be connected if EDM function is disabled. If EDM cable is connected when EDM function is disabled, it will be detected as error.

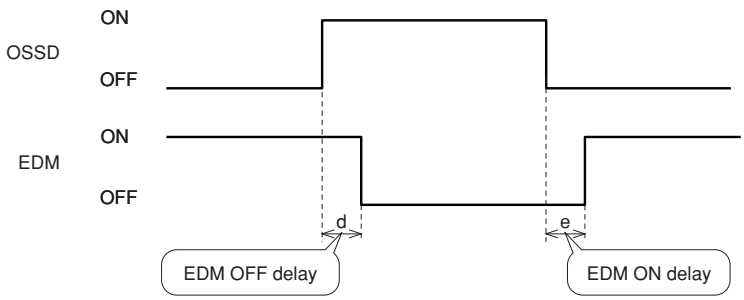


Figure 3-11. EDM timing chart

3.7 Muting

Muting function temporarily suspends the safety function in the configured zone of UAM when the specified conditions are fulfilled. During muting, the OSSD remains in ON-state even object is detected in the configured muting zone. Muting function is initiated and terminated using two independent hard wired input signals. Muting zone is configured using the Configurator (Refer to Chapter 7.16.5). When the muting inputs fulfill the muting start conditions, UAM will suspends the safety function within 60ms.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.7.1 Muting start condition

Muting function is initiated when the following conditions are fulfilled.

a) There are no objects in the protection zone and the OSSD is in ON-state.

b) The two independent hard wired muting input signal are switched in the predefined sequence. The sequence includes the switching order of the muting and the switching time interval T1 as shown in figure 3-12.

User can configure the muting initiation parameters using the UAM Configurator. (Refer to Chapter 7.16.5 for details)

- Muting inputs sequence
  - ▶ Muting 1 → Muting 2
  - ▶ Muting 2 ← Muting 1
- Time interval between two inputs (T1)
  - ▶ 1s
  - ▶ 3s
  - ▶ 5s
  - ▶ 10s

3.7.2 Muting stop condition

Muting function will be terminated when any one of the conditions below is fulfilled:

a) Anyone of the muting inputs switches to OFF-state.

b) The muting interval exceeds the maximum predefined interval (1 minute and above).

c) Objects are detected in the protection zone which is not covered by muting zone.

d) Error is detected by the self-diagnostics function.

e) When muting initiated area is switched to other area.

User can configure the muting termination parameters using the UAM Configurator. (Refer to Chapter 7.16.5 for details)

- Maximum muting period (T2)
  - ▶ 1 minute
  - ▶ 6 minutes
  - ▶ 12 minutes

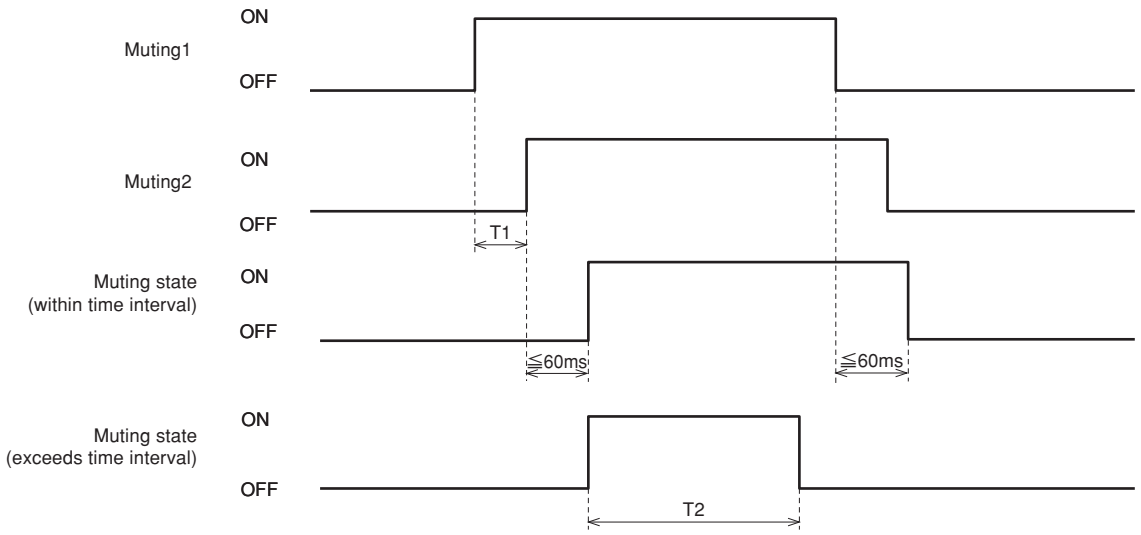


Figure 3-12. Muting sequence

 All Rights Reserved

3.7.3 Muting override function

Muting override is a function used to override all UAM protection features for a certain period when the OSSD is switched to OFF-state due to muting related errors. Override function is active when the override input and the reset input are switched in the sequence described below. 7-Seg LED displays the override code when the UAM is in override state. Figure 3-13 shows the override sequence.

- Override start conditions
  - ▶ At last one of the muting inputs is in ON-state
  - ▶ Object present in the protection zone
  - ▶ Time interval between override input and reset input is within 0.03s to 1s (T3)
- Override stop conditions
  - ▶ Both of the muting inputs are in OFF-state
  - ▶ Either override input or reset input is in OFF-state
  - ▶ Duration of the override exceeds time the configurable maximum override period T4
  - ▶ Error is detected by self-diagnostic function of the UAM
  - ▶ When override initiated area is switch to other area
- Maximum override period (T4)
  - ▶ 1 minute
  - ▶ 6 minutes
  - ▶ 12 minutes

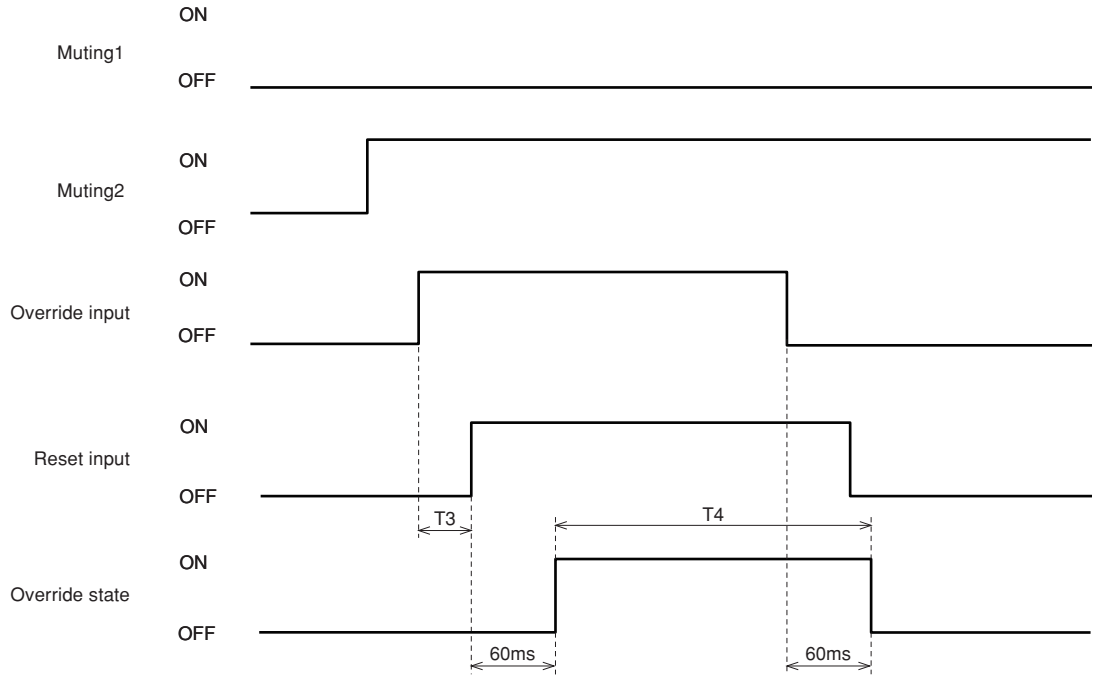


Figure 3-13. Override sequence

Danger

- User must ensure the safety of the protection zone when muting function is activated.
- Risk assessment must be performed before using muting function.
- Failing to comply with the above could lead to critical injury or death.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.8 Reference boundary monitor

Reference boundary monitor is a function to monitor the displacement of the UAM or the structure used as reference boundary.

3.8.1 Area protection

An example of reference boundary monitor function used for area protection is shown in figure 3-14. If reference segments are configured on moveable objects (example: door), the OSSD switch to OFF-state when position of the door is changed.

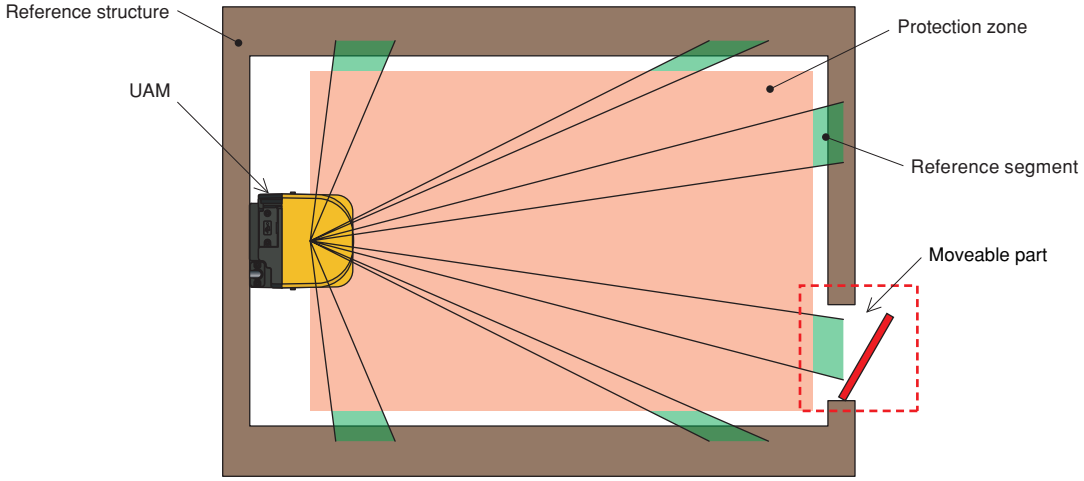


Figure 3-14. Top view of the area protection using reference boundary monitor function

3.8.2 Access protection

An example of reference boundary monitor function used for access protection is shown in figure 3-15. User is required to configure the reference segments on each surface for displacement detection. Reference segments should be configured such that displacement is easily detected. The OSSD will switch to OFF-state when access penetration is detected, and also if the distance between UAM and the reference structure changes.

This function is compulsory for vertical applications.

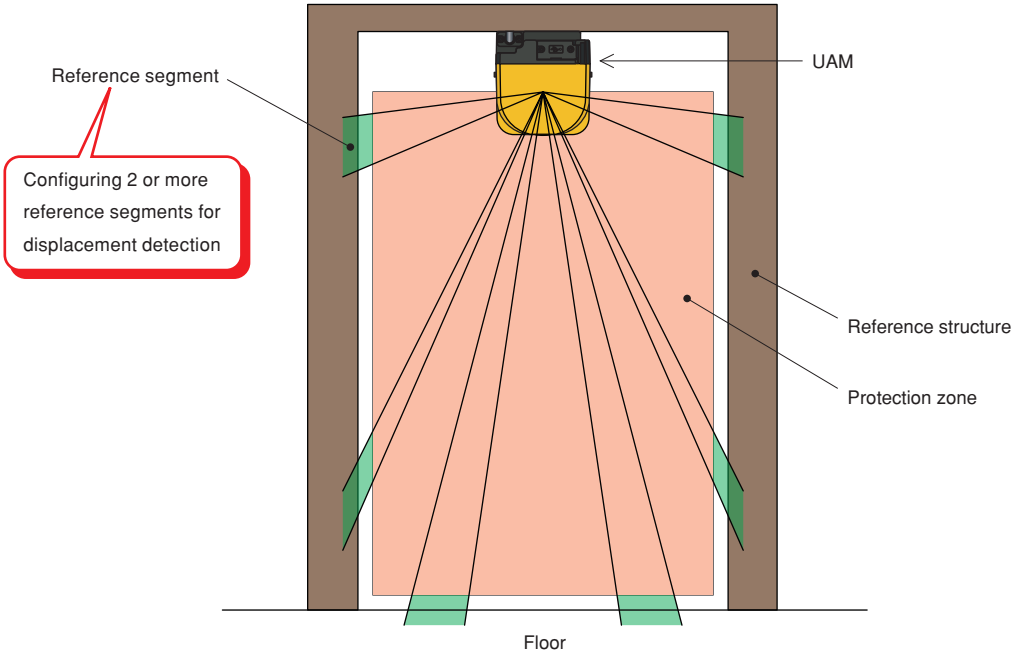


Figure 3-15(a). Front view of the access detection using reference boundary monitor function 1

 All Rights Reserved

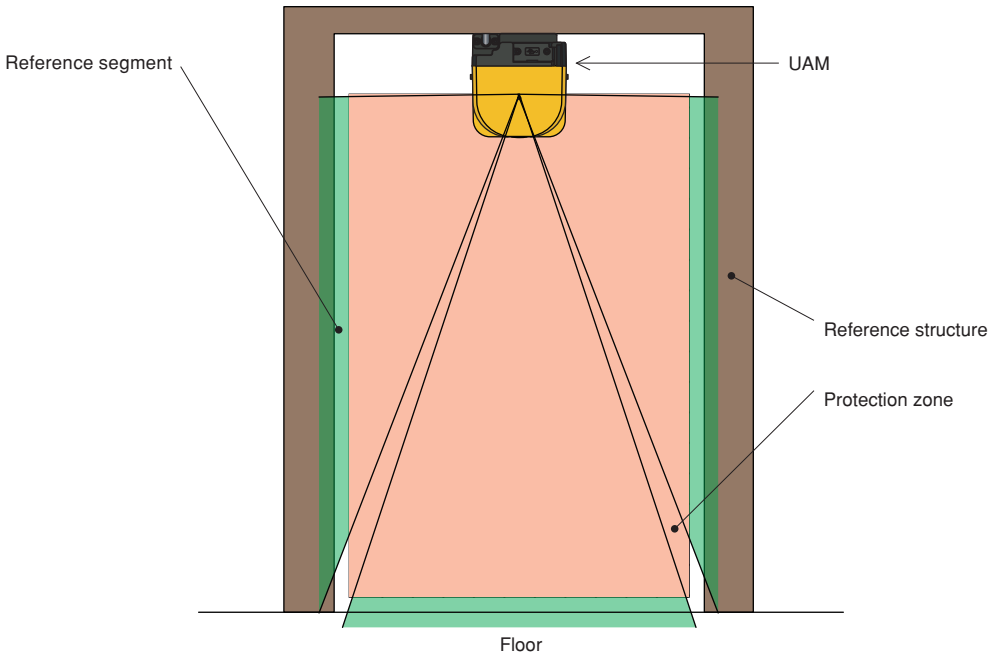


Figure 3-15(b). Front view of the access detection using reference boundary monitor function 2

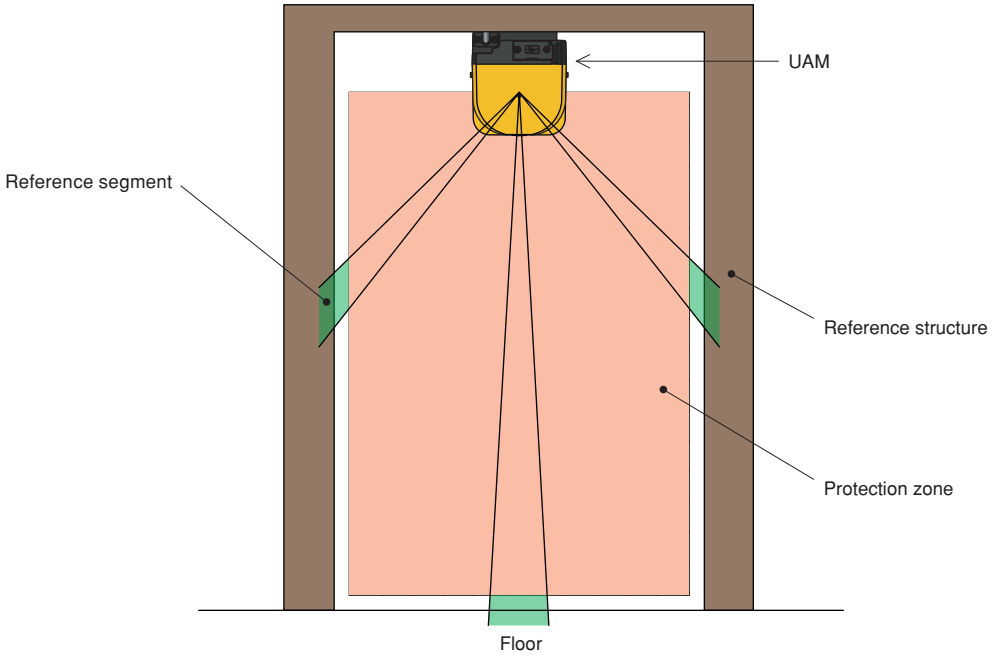


Figure 3-15(c). Incorrect configuration of reference boundary segment

3.9 Area sequence

Area sequence is a function to monitor sequences of area switching. If UAM detects switching pattern other than the preset sequence OSSD goes to OFF-state. This function prevents the machine to operate with an unintended protection zone.

From each area, switching selection to maximum 15 other areas are possible when configuring the area sequence. If muting function is enabled area selection will be reduced to maximum 7.

Note ● Sensor version 2.0.0 does not have area sequence function.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

＜Area switching sequence＞

When area sequence is disabled UAM can switch from an area to any other areas (Fig. 3-16(a)) whereas it can only switch to specific areas if area sequence is enabled (Fig. 3-16(b)).

It is recommended to use this function in systems where area sequence is fixed.

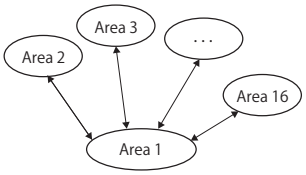


Figure 3-16(a) Operation without area sequence

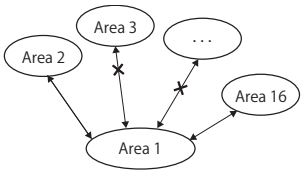


Figure 3-16(b) Operation with area sequence

3.10 Response time

Response time of OSSD signal is configurable using the UAM Configurator application software. Response time of the Warning1 and 2 will be same as the OSSD response time. Availability of the UAM can be increased by configuring longer response time. However, longer response time requires longer safety distance (Chapter 4). Operator must perform risk assessment before configuring the response time. Table 3-4 shows the configurable response time. Addition of 30ms has to be taken into account during area switching.

Table 3-4. Response time of UAM

	Response time (ms)														
OFF	60	90	120	180	210	240	270	300	330	360	390	420	450	480	510
ON	270							300	330	360	390	420	450	480	510

3.11 Other Output

UAM consist of 3 non-safety outputs, WARNING1, WARNING2/ERR/MUT_OUT, and Ready/RES_REQ. Warning2/ERR/MUT_OUT (Warning2 by default), and Ready/RES_REQ (Ready by default) are configurable outputs that share the same terminal. Configuration of the output can be done through the Configurator.

3.11.1 Warning output (WARNING1)

This signal will switch to OFF-state when an obstacle is detected in the configured warning zone 1.

3.11.2 Warning output (WARNING2)

This signal will switch to OFF-state when an obstacle is detected in the configured warning zone 2.

3.11.3 Error output (ERR)

ERR output indicates the operation status of the UAM. The signal will switch to OFF-state when error is detected during self-diagnostic of the UAM. Refer to Chapter 9 for details on detected error and possible solutions.

3.11.4 Muting output (MUT_OUT)

MUT_OUT indicates the muting/override status of the UAM. When the muting is activated, MUT_OUT will switch to ON-state. At the same time, number 18 is displayed on the 7-Seg LED when the muting is activated. When override is activated, number 19 is displayed. This signal should be used to indicate the UAM is in muting state.

3.11.5 Ready output (READY)

The signal will switch to ON-state when the UAM is ready for operation.

3.11.6 Reset Request (RES_REQ)

This signal will switch to ON-state when the UAM is ready to receive reset signal.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

3.12 Information indicator

LEDs and 7-segment display indicate the UAM status. These indicators are located on the front of UAM. Figure 3-17 shows the information indicators of UAM.

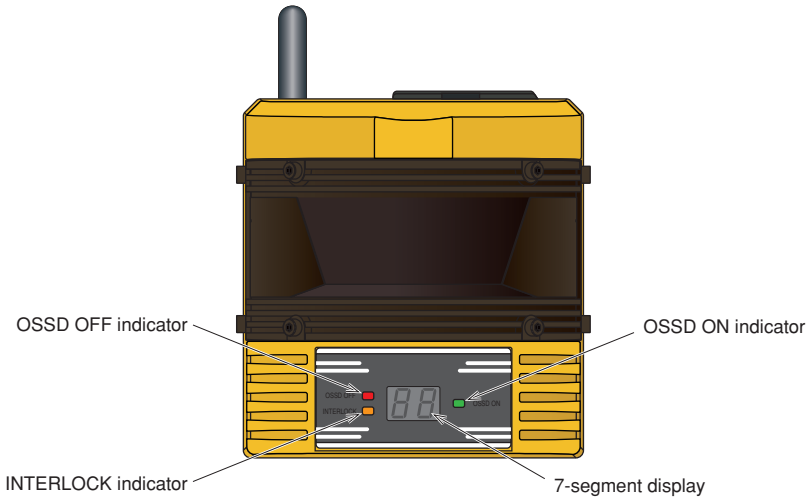


Figure 3-17. Information indicator of UAM

3.12.1 LED

Descriptions of the LED and are shown in Table 3-5 and below.

Table 3-5. Description of the LED

LED	Description
OSSD OFF (Red)	OSSD signal is in OFF-state
INTERLOCK (Orange)	UAM is in interlock state
OSSD ON (Green)	OSSD signal is in ON-state

3.12.2 7-segment display

Display number	Details
1	Area 1
2	Area 2
3	Area 3
4	Area 4
5	Area 5
6	Area 6
7	Area 7
8	Area 8
9	Area 9
10	Area 10
11	Area 11
12	Area 12
13	Area 13
14	Area 14
15	Area 15
16	Area 16
17	Reset request
18	Muting activated
19	Override activated

Note: Display numbers other than the above are error state. Refer to table 9-2 for details.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

4. UAM application examples

The section describes some application examples using the UAM and calculation of safety distance in the respective application. When using the UAM as protective equipment, guidelines below should be taken into account:

a) Hazard should be identified and risk assessment should be carried out

b) UAM should not be used for finger protection

c) Working environment should be within the specification of UAM

d) Safety distance must be determined in accordance to ISO 13855 & IEC 61496-3

Danger ● Configuring the UAM beyond it's specification could lead to critical injury and death.

Note ● Read through the user's manual before configuring the UAM.

4.1 Area protection (Horizontal application - Stationary)

In this kind of application, UAM is mounted horizontally to protect the hazardous area. Figure 4-1 shows an example of the horizontal application. The protection zone is configured around the hazardous area to prevent any human or object from entering the hazardous area. Warning zone 1 and 2 are configured surrounding the protection zone. These warning zones can be used as an alert to any object or human from approaching the protection zone and preventing unnecessary stops of the protected machine. Any objects or humans detected in the protection zone will cause the OSSD signal to switch from ON-state to OFF-state. Any objects and humans detected in the warning zones will cause the warning signal to switch from ON-state to OFF-state as well. The safety distance for this application is shown in figure 4-2 and 4-3.

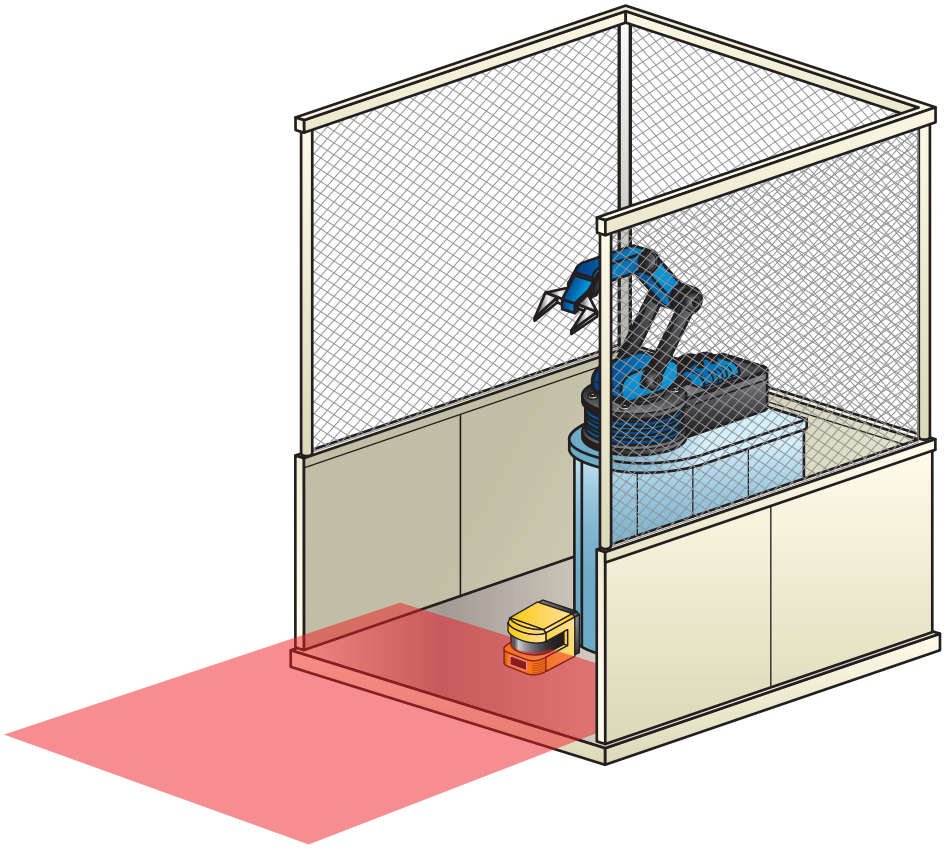


Figure 4-1. Example of stationary application (horizontal)

 All Rights Reserved

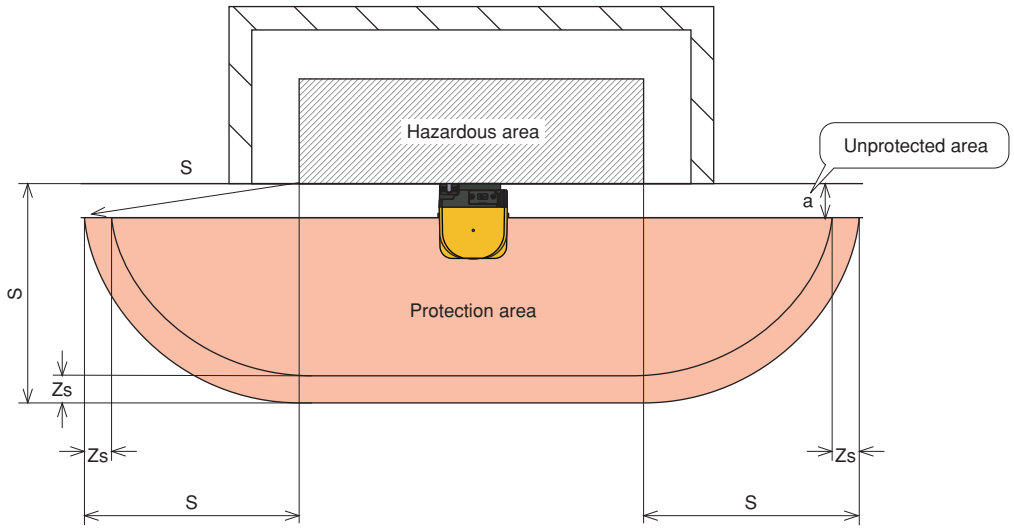


Figure 4-2. Top view of the horizontal application

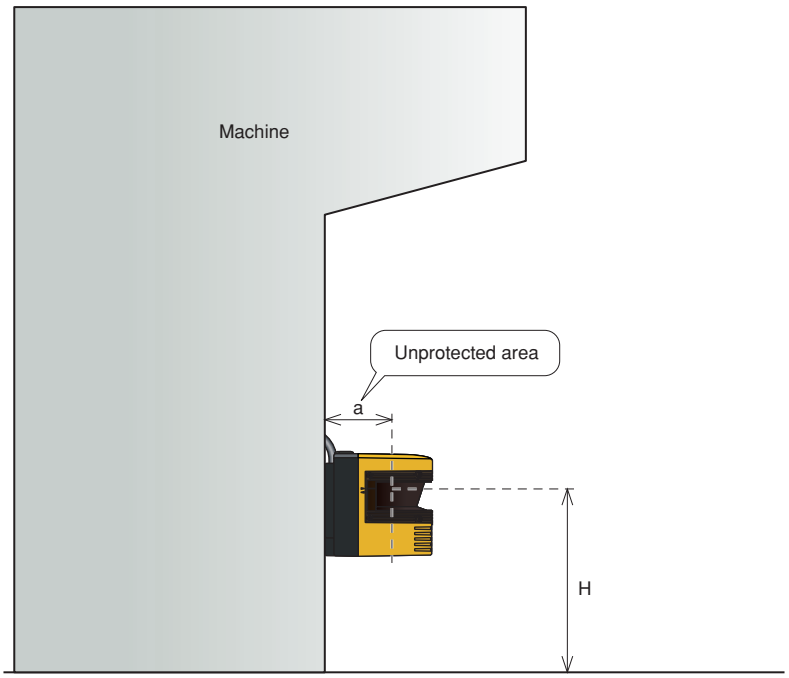


Figure 4-3. Side view of the application

Safety distance calculation:

$S=(K\times(T_m+T_s))+C+Z_s$

where:

S =Safety distance (mm)

K =Approach speed 1600 (mm/s)

T_m=Maximum stopping/run-down time of the machine or system (s)

T_s =Response time of UAM (s)

C =1200-0.4×H≧850

H =the height at which the protective field is mounted (mm)

1000≧H≧15×(d−50)

d =Minimum detectable object width (mm)

Z_s =UAM tolerance distance (mm)

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- The distance between the hazard area edge and origin of the protection zone must be less than the minimum detectable width. User must ensure that the value of “a” is smaller than the minimum detectable width. In applications where the value of “a” is greater than the minimum detectable width, additional protective measures must be taken to prevent penetration through this unprotected area.
- UAM should not be mounted higher than 300mm to prevent the possibility of crawling beneath the detection plane.
- For applications which require the UAM to be mounted higher then 300mm, additional measures must be taken to prevent intrusion beneath the detection plane.
- If UAM is mounted in a public area, the detection plane should be reduced to 200mm or the height required by regulations of the local authority.
- In obstacles detection application, if direction of approach is parallel to the detection plane, minimum detectable width should be set below 70mm.

Note

- If appropriate, indications/markings on the floor of the protection zone is strongly recommended.
- Distance tolerance must be taken into account when configuring the safety distance.
- Additional distance must be added if UAM works in high reflective background
- Operator must ensure that boundary or protective measures used are not detected in the protected area. It will be detected as obstacles and cause the OSSD to remain in OFF-state

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

4.2 Area protection (Horizontal application - Mobile)

UAM can be used for mobile applications. Figure 4-4 shows an example of a mobile application on Automatic Guided Vehicle (AGV). UAM on the AGV detects intrusions of human or obstacles while travelling on the fixed routes. Warning zones signals can be used to reduce the AGV's speed and OSSD signal can be used to stop the AGV if necessary. Area switching function of the UAM enables the AGV to switch between 16 different sets of area patterns in accordance to the travelling routes. For mobile applications, time required for the AGV to reach a complete stop state has to be taken into account when configuring the protection zone and warning zones. Safety distance for this application is shown in figure 4-5 and 4-6.

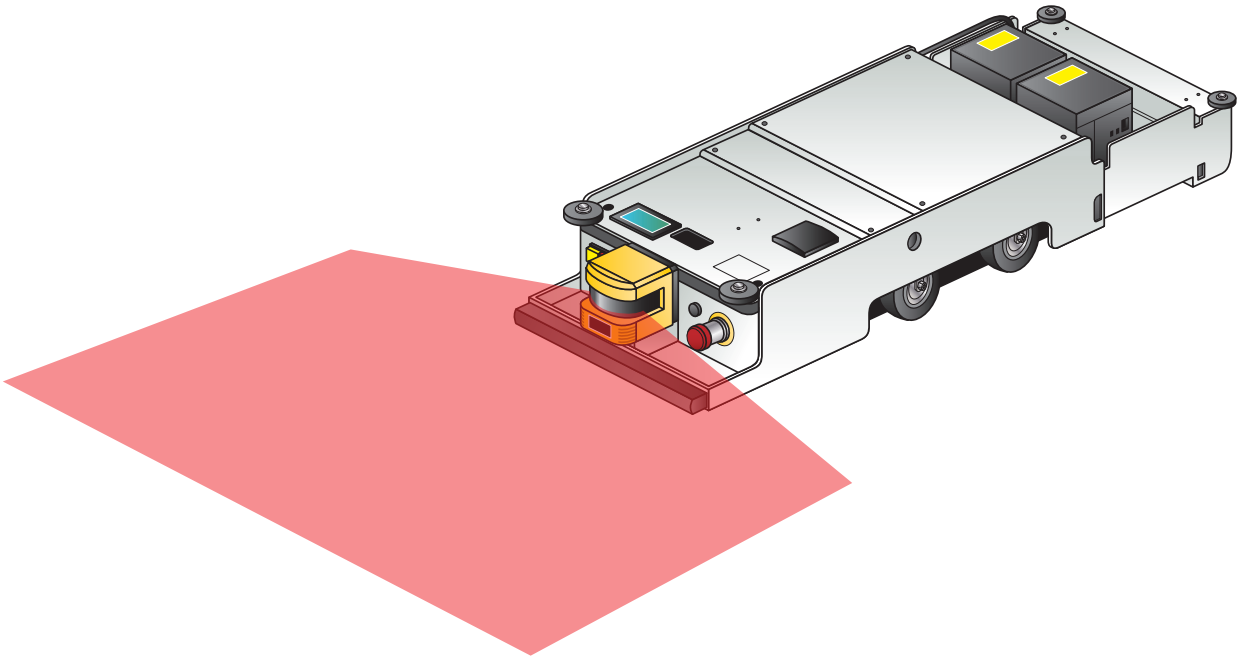


Figure 4-4. Example of mobile application

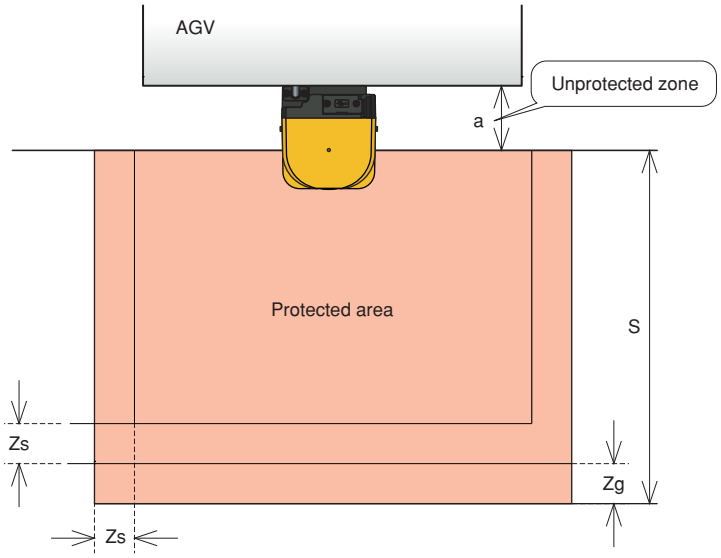


Figure 4-5. Top view of the application

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

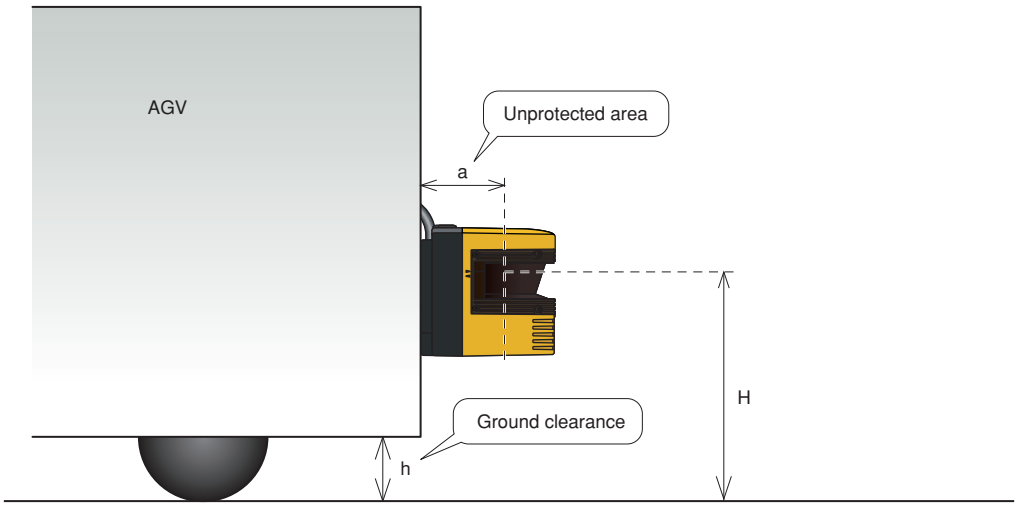


Figure 4-6. Side view of the application

Safety distance calculation:

$S = V \times (T_m + T_s) + Z_b \times L + Z_s + Z_g$

where:

S = Safety distance (mm)

V = Maximum approaching speed of AGV (mm/s)

T_m = Maximum stopping/run-down time of the machine or system (s)

T_s = Response time of UAM (s)

Z_b = Distance required for AGV to stop (mm)

L = Brake wear coefficient

Z_s =UAM tolerance distance (mm)

Z_g =Additional of distance with the lack of ground clearance (mm)

h=ground clearance (mm)

User should secure sufficient ground clearance to prevent toe injury. The relation between ground clearance and Z_g is shown in figure 4-7.

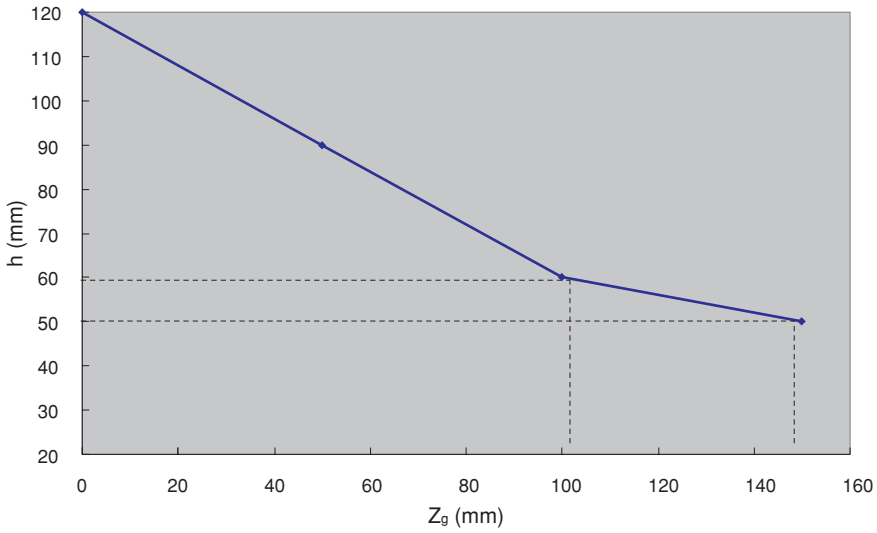


Figure 4-7. The relationship between Z_g and h

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- User must ensure that the width of unprotected area “a” is smaller than the minimum detectable width. In applications where the value of “a” is greater than the minimum detectable width, additional protective measures must be taken to prevent penetration through this unprotected area.
- UAM should not be mounted higher than 200mm to prevent the possibility of crawling beneath the detection plane.
- Detection plane should not be tilted as this could lead the UAM fail to detect an object with a diameter of 200mm.

Note

- Operator must ensure that boundary or protective measures used are not inside the configured protected zone. It will be detected as obstacles and cause the OSSD to remain in OFF-state.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

4.3 Access protection (Vertical application - whole-body detection)

UAM can be used vertically in creating a protection shield. Figure 4-8 shows an example of vertical application. Such application is generally used for access protection at the hazardous area. When any object or human tries to accesses, the OSSD signal will switch from ON-state to OFF-state. When installing UAM for vertical application, users have to be aware that vertical application detects objects or humans at the detection plane. Detection of object or human before or after the detection plane is not possible. Therefore, distance between the entry and the hazardous area has to be carefully configured. User must use the reference monitoring function for this kind of application. OSSD signal will switch to OFF-state when there are changes in reference points. Safety distance of this application is shown in figure 4-9 and 4-10.

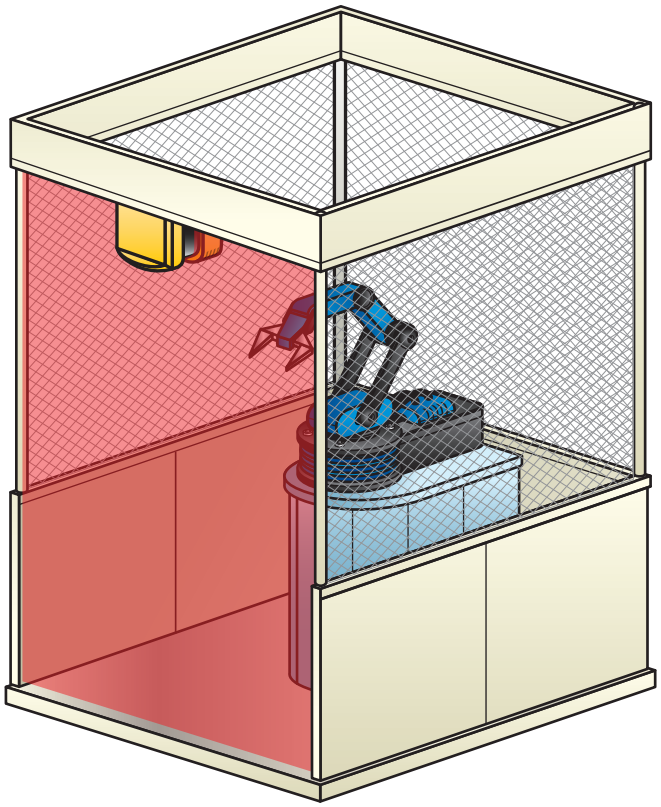


Figure 4-8. Example of access protection application

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

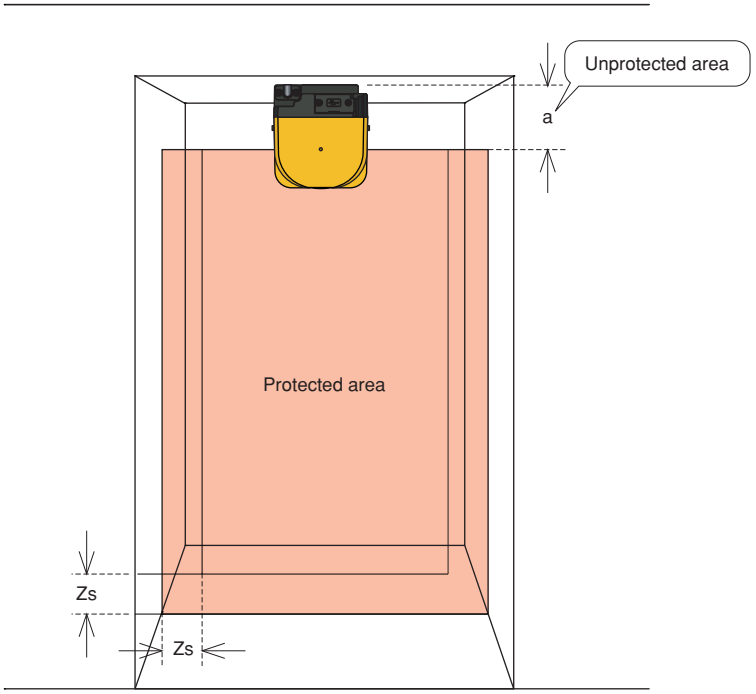


Figure 4-9. Front view of the application

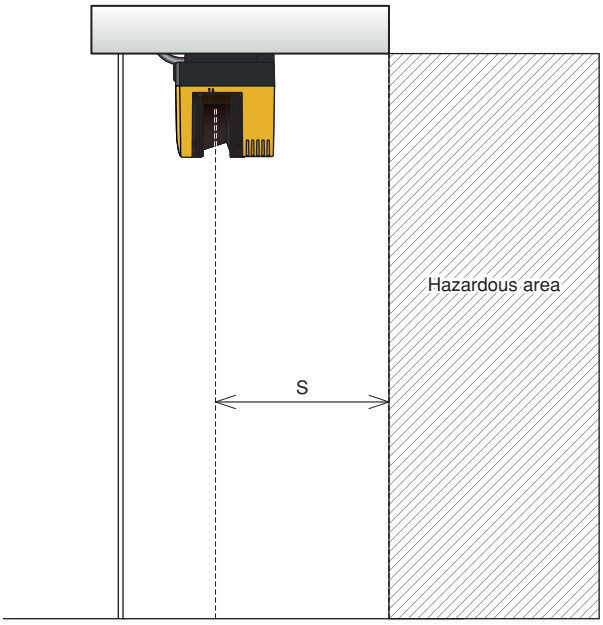


Figure 4-10. Side view of the application

Safety distance calculation

$$S = (K \times (T_m + T_s)) + C$$

where:

S = Safety distance (mm)

K = Approach speed 1600 (mm/s)

T_m = Maximum stopping/run-down time of the machine or system (s)

T_s = Response time of UAM (s)

C = Additional distance of 850mm by considering arm intrusion (mm)

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- In the access protection application, where the angle of the approach exceeds ±30°,"Reference monitoring" function must be used. Response time must be configured 90ms or less in the access protection application. Tolerance of the reference segment should be configured as 100mm.
- Reference segments must be configured on each reference boundary.
- UAM should be mounted in such a way that access through hazardous point is impossible. Use additional protective measures if necessary.
- User must ensure that the width of unprotected area, "a" is smaller than the minimum detectable width. In applications where the value of "a" is greater than the minimum detectable width, additional protective measures must be taken to prevent penetration through this unprotected area.
- Tolerance must be included when configuring the reference segments.

Note

- If minimum detectable width is configured at 30mm, the C's value can be replaced with 0.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

4.4 Access protection (Vertical application - body parts detection)

UAM can be used vertically in creating a protection shield. Figure 4-11 shows an example of vertical application. Such application is generally used in order to prevent body parts from reaching a hazardous area. When any object or human body parts access the entry, this will switch the OSSD signal ON-state to OFF-state.

When installing UAM for vertical application, users have to be aware that vertical application detects objects or human at the detection plane. Detections of object or human before or after the detection plane is not possible. Therefore, distance between the entry and the hazardous area has to be carefully determined. The width of the protection zone must be configured wide enough to cover the hazardous area.

User must use the reference monitoring function for this kind of application. OSSD signal will switch to OFF-state when there are changes in reference points.

Safety distance for this application is shown in figure 4-11 and 4-12. Configure the protection zone as described in section 7.16.

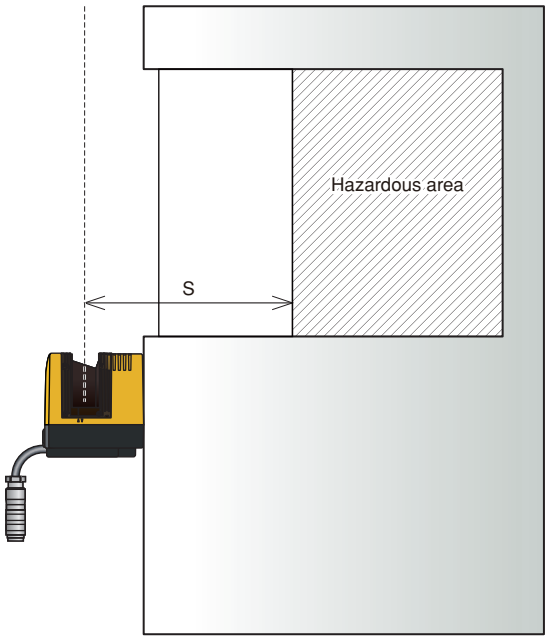


Figure 4-11. Side view of the application

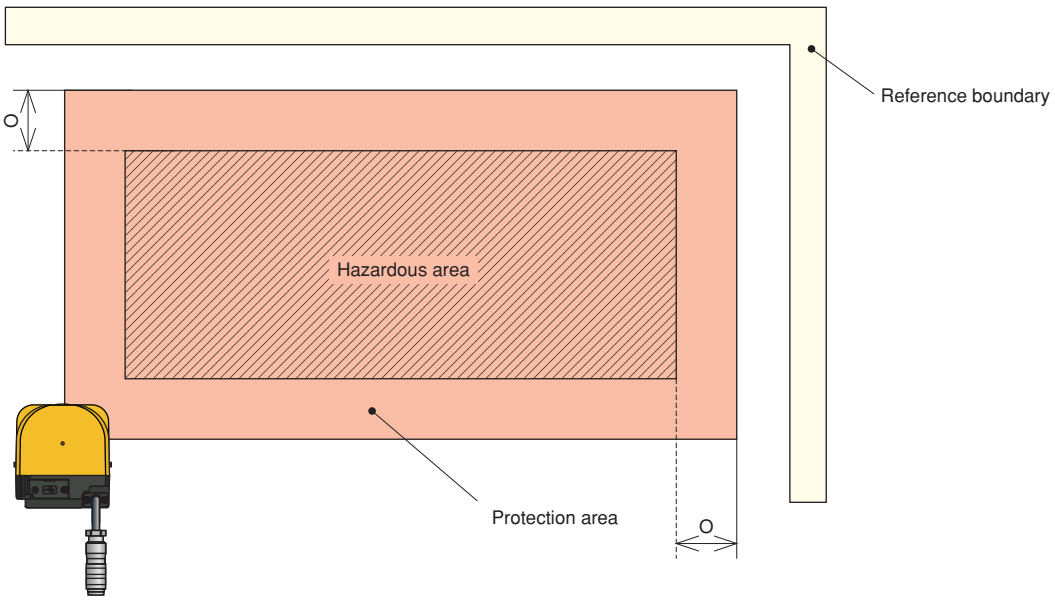


Figure 4-12. Front view of the application

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Safety distance calculation

$S = (K \times (T_m + T_s)) + C$

where:

S ＝Safety distance (mm)

K ＝Approach speed 2000 (mm/s)

T_m＝Maximum stopping/run-down time of the machine or system (s)

T_s＝Response time of UAM (s)

C ＝Additional distance

＝8×（d－14）

d＝Minimum detectable object width (mm)

O＝Additional width from edge of hazard source

≧（ $2 \times Z_s$）－d

d＝Minimum detectable object width (mm)

Z_s＝UAM's tolerance distance (mm)

Danger

- In the access protection application, where the angle of the approach exceeds ±30°, "Reference boundary monitoring" function must be used.
- Reference segments must be configured on each reference boundary.
- Tolerance of the reference segment should be lesser than 100mm.
- For detection of body parts, minimum detectable width must be configured at 30.0mm.
- UAM should be mounted in such a way that accessibility towards hazardous point is impossible. Use additional protective measure if necessary.

Note

- When the S＞500mm, the K value can be replace with 1600mm/s instead of 2000mm/s. In that case, S must be greater than 500mm

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

5. Installation

5.1 Light interference

UAM transmits pulsed laser for obstacle detection. Interfering light sources could lead to false detection. User should carefully examine the surroundings before installation, especially avoiding the following light sources.

i) Incandescent light

ii) Fluorescent light

iii) Stroboscopic light

iv) Flashing beacon

v) Sunlight

vi) Infrared light sources

However, if the light sources mentioned above cannot be avoided in the working environment, the UAM should be installed with the light sources located at≧5° from the detection plane to avoid interference on detection (Figure 5-1).

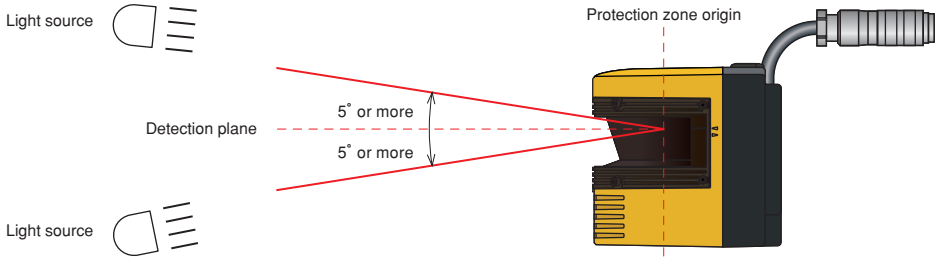


Figure 5-1. Installation under light interference

Danger

- User must perform risk assessment for interference lights in the working environment before installation.
- Direct interference light such as stroboscopic, flashing beacon, fluorescent must be avoided.
- Failing to comply this will lead to critical injury and death.

Caution

- Operator must verify the detection capability of the UAM when the above measure is taken.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

5.2 Mutual interference

Pulsed laser signal from identical UAM could lead to false detection. Extra measures are required in application that uses multiple identical UAMs. Figures below show some of the possible installation methods to avoid mutual interference.

i) Changing the height of installation

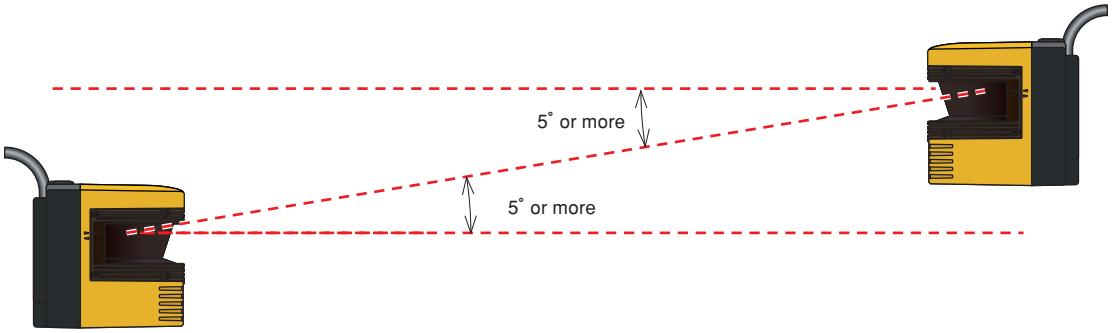


Figure 5-2. Opposite facing installation

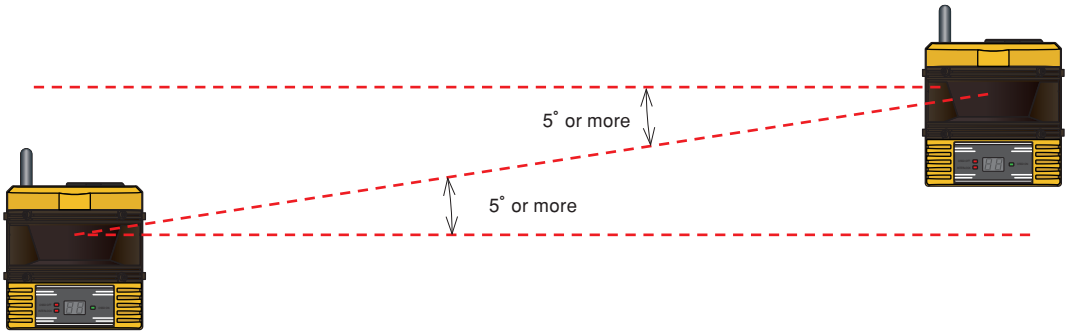


Figure 5-3. Parallel installation

ii) Changing the angle of installation

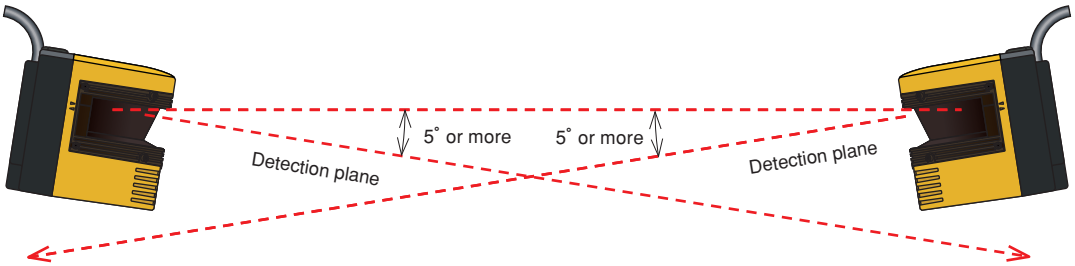


Figure 5-4. Opposite facing installation

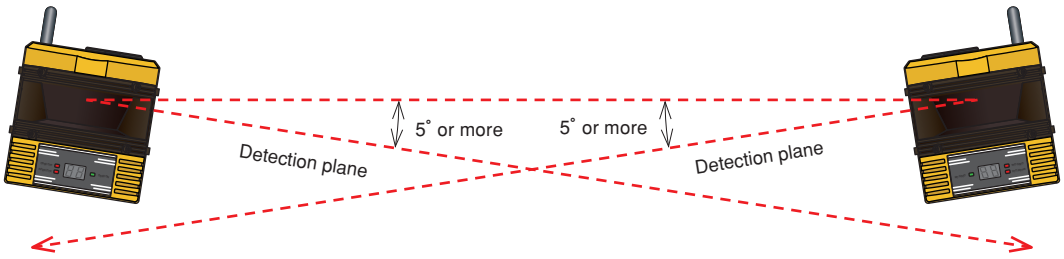


Figure 5-5. Parallel installation

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

iii) Adding shield in between the UAM

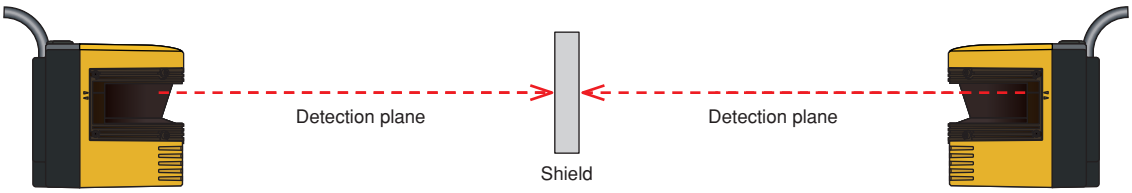


Figure 5-6. Opposite facing installation

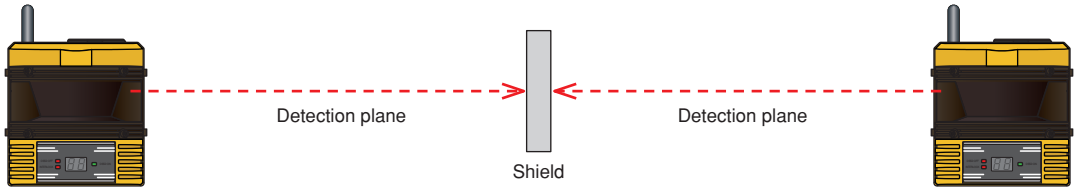
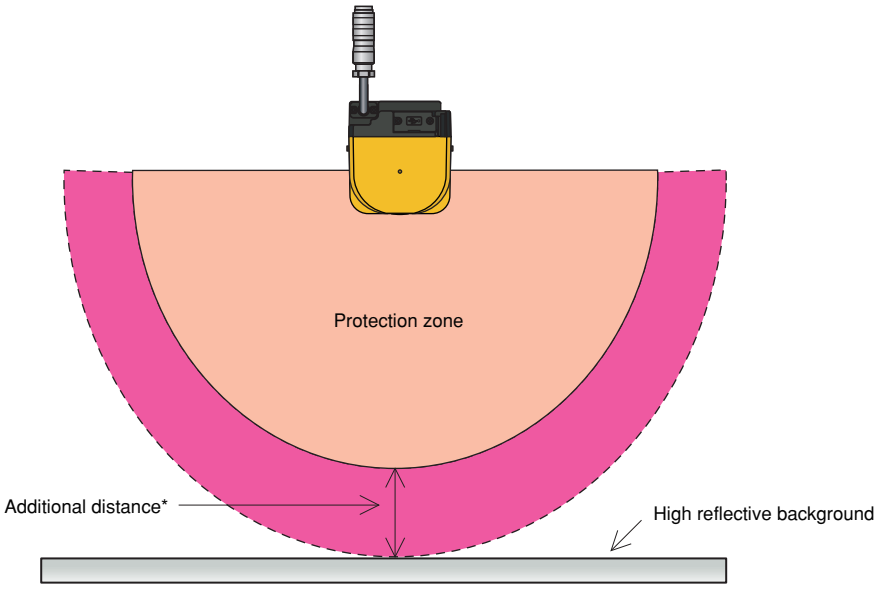


Figure 5-7. Parallel installation

Note ● Material of the shield must be solid and non-transparent.

5.3 High reflective background

High reflective background leads to false detection. High reflective background results in a longer detected distance than the actual value. When high reflective background cannot be avoided in the working environment, additional distance is needed when configuring the protection and warning zones (Figure 5-8). Refer to UAM's specification for the required distance tolerance.



*Additional distance = Additional distance tolerance for UAM operating under high reflective background.

Figure 5-8. Additional distance under high reflective background

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- Measured distance is longer than actual distance if the background is highly reflective.
- Additional distance must be added when configuring the protection zone.
- High reflective background (Ex.: mirror, corner cube reflector, reflective safety jacket, road reflector) must be avoided. Reflectance caused by these reflective materials could lead to false detection in the protection zone.
- Verify the configured areas before operation.
- Failing to comply with this will leads to critical injury and death.

5.4 Limited detection capability zone

The limited detection capability zone is defined as a region between the optical window and the beginning of the detection zone. The limited detection capability zone of the UAM is 87mm from the origin of UAM (Figure 5-9). UAM has difficulty in detecting presence of object with low reflectivity in this area.

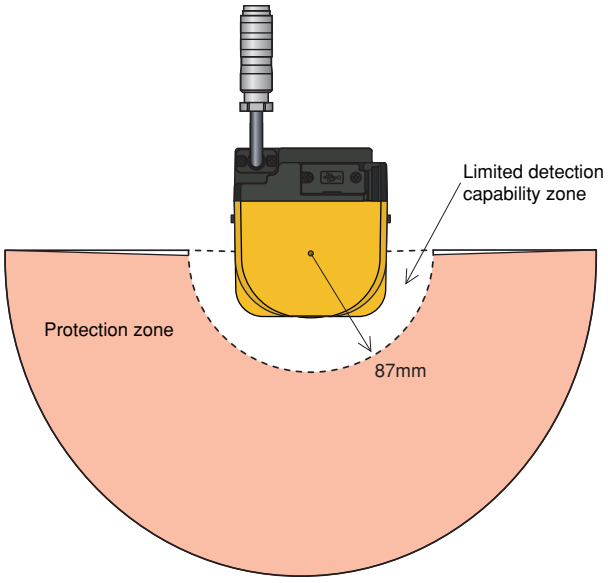


Figure 5-9. Limited detection capability zone

Danger

- User must perform safety assessment for possibility of object penetration into the limited detection capability zone.

 All Rights Reserved

6. Wiring

This chapter describes wiring examples and the precautions during installation.

6.1 Precautions

a) Make sure the power supply is disconnected or switched OFF during all electrical wiring.

b) Do not use cable longer than the length stated in the specification of the UAM. Safety function may not operate properly if longer cable is used which could lead to serious injury or death.

6.2 Power supply

Ensure the power supply is within the range of DC 24V±10%. For battery operation, power supply must be within the range of DC 24V -30% / +20%. Excess power supply could damage the UAM.

Danger ● Do not use cable longer than the length stated in the specification of the UAM.

Caution ● For safety, switch OFF the power supply during electrical wiring.

6.3 Wire colour and coding

Table 6-1below shows the function of the wires. A shielded cable is recommended for wiring.

Table 6-1. Wire colour and coding table

Colour	Signal	Function	Description	AWG
Brown	+24V DC	Power	Power DC 24V	22
Blue	0V DC		Power 0V	
Red	OSSD 1	Output	Protection zone output 1	26
Yellow	OSSD 2		Protection zone output 2	
Purple	IN_A	Input	Area Switching Input A	28
Gray	IN_B		Area Switching Input B	
White	IN_C		Area Switching Input C	
Pink	IN_D/MUTING1		Area Switching Input D/Muting input 1	
Purple/Black	IN_Ā		Area Switching Input Ā	
Gray/Black	IN_B̄		Area Switching Input B̄	
White/Black	IN_C̄		Area Switching Input C̄	
Pink/Black	IN_D̄/MUTING2		Area Switching Input D̄/Muting input 2	
Green	EDM		External device monitoring	
Red/Black	WARNING1	Output	Warning zone Output 1	
Yellow/Black	WARNING2/ ERR/MUT_OUT		WARNING2: Warning zone output 2 ERR: OFF when diagnostic error detected MUT_OUT: Muting state output	
Orange	READY/ RES_REQ		READY: ON during Normal operation RES_REQ: ON when external reset is needed	
Green/Black	RESET	Input	Reset input	
Orange/Black	OVERRIDE		Override input	
Shield wire	FG	——	Frame ground	——

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

6.4 Wiring example

Figure 6-1 below shows a wiring example for the UAM.

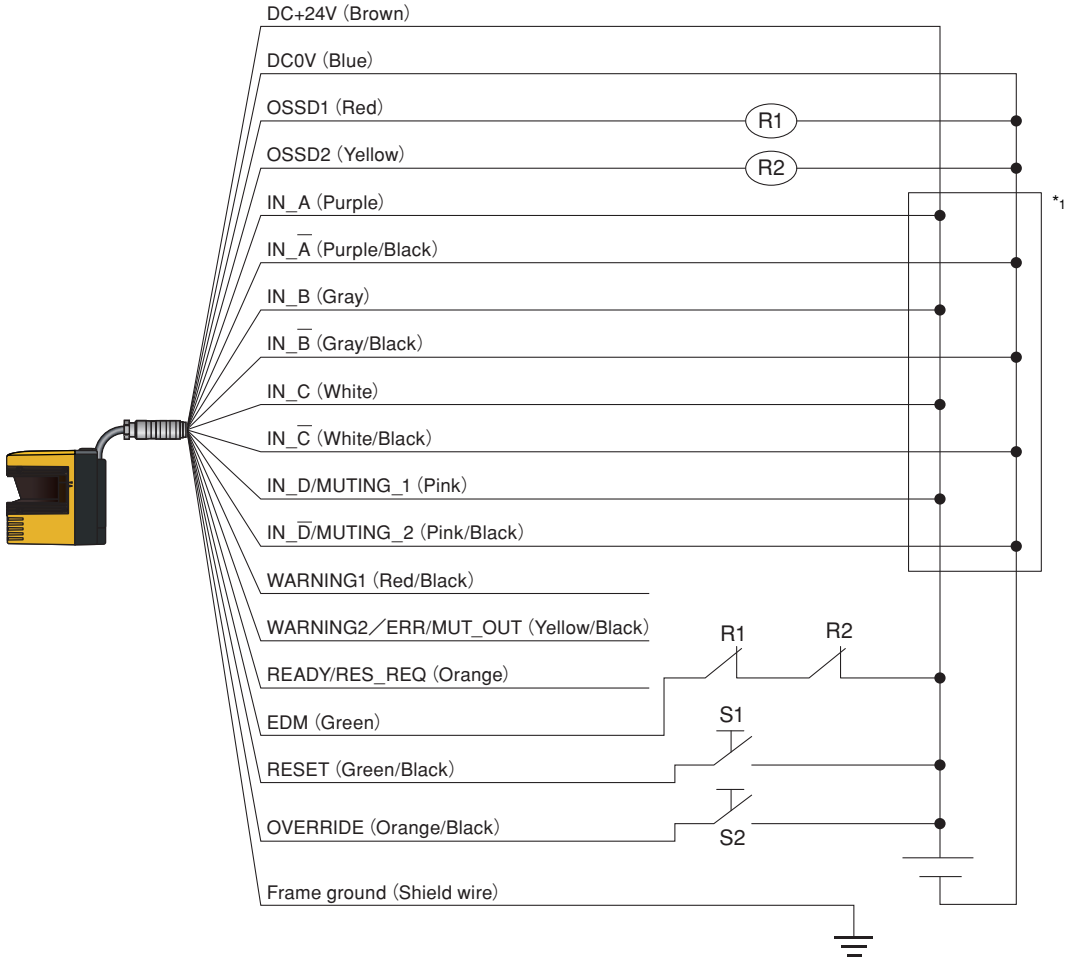


Figure 6-1. Wiring example

R1, R2: External device (Safety relay, Magnet contactor, etc.)

S1: Interlock-reset switch

*1: Please refer to section 3.4 for details on area switching.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

6.5 Input/Output circuit

6.5.1 OSSD output circuit

OSSD are output source type.

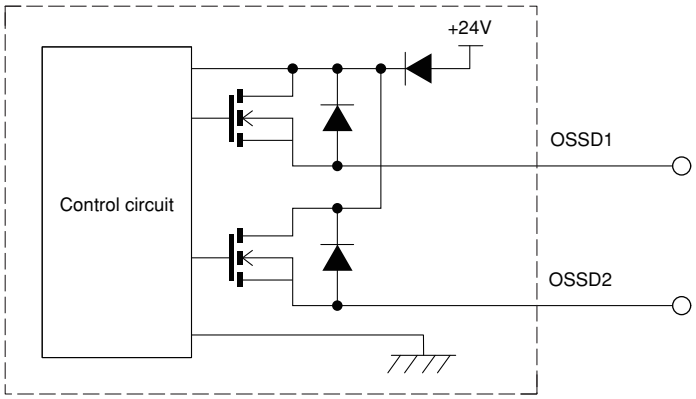


Figure 6-2. OSSD output circuit

6.5.2 Other Output circuit

WARNING1, WARNING 2, READY outputs are PNP type.

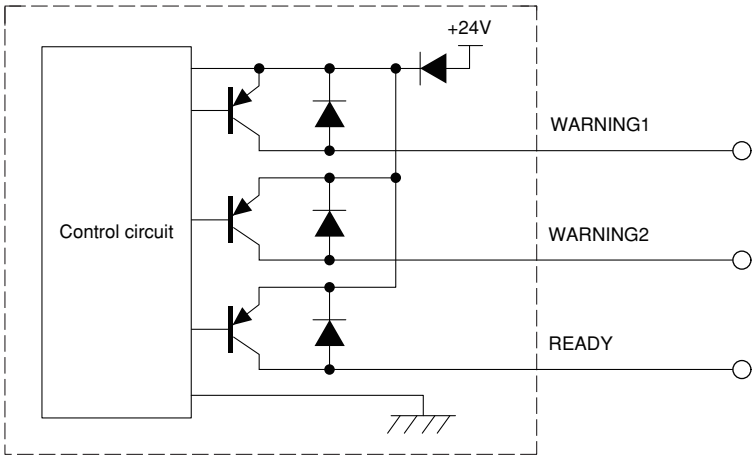


Figure 6-3. Output circuit

6.5.3 Input circuit

Input circuit shows in figure 6-4 is applicable for area inputs, EDM, RESET, MUTING1, MUTING 2 and OVERRIDE.

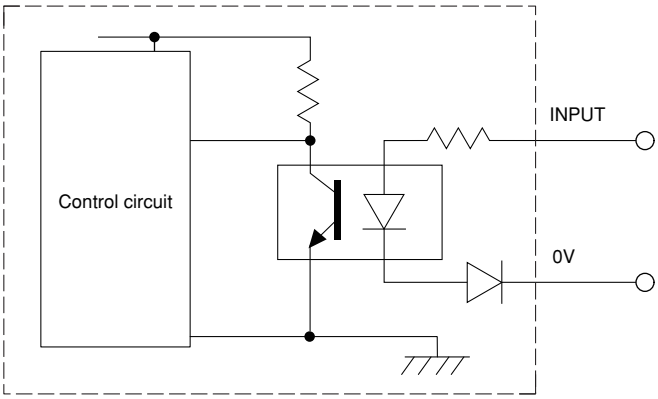


Figure 6-4. Input circuit

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7. UAM Configurator application software

7.1 About UAM Configurator Application Software

This application is developed for the UAM. This application is developed for the following functions:

a) Display the measurement data

b) Protection zone, warning zone configuration

c) Function configuration

d) Measurement data

e) Project data management (configuration data storage and retrieval)

Caution ● Read this manual before configuring the UAM.

Note ● Figures, illustrations, displayed dialogue boxes and indications in this manual may differ slightly depending on user's system or environment.

7.2 System requirements

Item	Description
Interface	USB 1.1/2.0
Compatible OS	Windows XP® Professional edition (32-bit, SP3 or later) Windows Vista® Business edition (32-bit) Windows 7® Ultimate edition (32-bit) Windows 7® Professional edition (64-bit)
Minimum RAM	A minimum of 256MB and above
Media Drive	Internal or external CD-ROM drive
Hard Disk	100MB minimum free space
Software requirement	UAM Configurator relies on Microsoft .NET Framework 2.0 SP1, which is automatically installed if it is not already on the system.

Note: Requirements to install Microsoft's .NET framework:

a) Processor: 400MHz (Min.)

b) RAM: 96MB (Min.)

c) Disk space: 280MB (32-bit)

d) Additional software: IE 6.0 and above, Windows Installer 3.0 and above

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.3 UAM driver installation

Note

- Be sure to connect the UAM to the PC with the USB cable (purchase separately) before installing the UAM driver.
- Driver installation is necessary for PC to interface with the UAM.
- Driver only needs to be installed once. If the PC is previously installed with the driver, user can skip this driver installation instructions and proceed with the UAM Configurator installation.

Follow these steps to install the UAM's driver:

a) Connect the UAM to PC's USB port. PC will detect the new hardware and open the "Found New Hardware Wizard".

b) Select "Install from a list or specific location (Advanced)", insert the CD then click [Next>].

c) Select "Search for the best driver in these locations". Then select "Include this location in the search", and click [Browse].

d) Select the "Driver" folder, then click [OK].

e) Click [Next>].

f) The wizard starts searching for the driver and dialogue box is shown.

g) Windows starts installing the UAM driver.

h) After clicking [Finish], the dialogue appears indicating new hardware is successfully installed.

To confirm that the UAM driver was successfully installed, go to the computer's device manager and expand the "Ports (COM and LPT)" list, "URG Series USB Device Driver" should be seen as one of the COM ports.

7.4 UAM Configurator application software installation

a) Insert the CD into the CD-ROM drive.

b) Click "Setup.exe". This file is located at "CD:\EN\setup.exe".

c) Follow the instructions of the installer and complete the installation.

Note

- For Windows XP, user need to log-in as "Administrator" to authorized the installation of the UAM Configurator.
- Installation can not proceed if user log-in other than "Administrator".
- For Windows XP, UAM Configurator is installed into "C:\Program Files\Hokuyo Automatic \UAMConfigurator" by default. If user prefer it to be install in different folder, change this location during the installation process.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.5 Starting the UAM Configurator application software

There are 2 ways to start the UAM Configurator

a) For Windows XP, [Start]→[Program]→[UAMConfigurator]→[UAM_Configurator]

b) Double click the short-cut icon on the PC desktop as shown below:

Figure 7-1. Desktop icon

7.6 Uninstall

a) Start up Windows.

b) Select the "Control Panel" in the Start menu.

c) Click the "Add or Remove Programs".

d) Select "UAMConfigurator", then click [Change/Remove].

e) The "Ready to uninstall UAMConfigurator ?" appears. Click [Yes] to uninstall the program from the PC.

f) After the uninstall is completed, click [OK]. Restarting the PC is recommended.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.7 Startup main window

a) A main window as shown in Figure 7-2 will be displayed after the UAM Configurator is started.

Figure 7-2. Main window

b) Select one of the startup methods and continue by clicking the [OK] button.

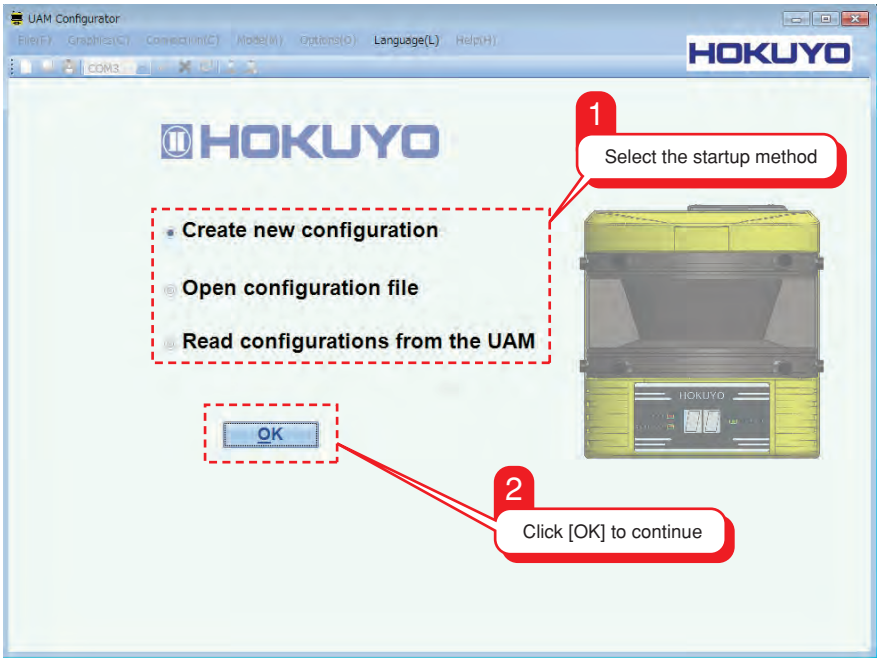


Figure 7-3. Main window components

Table 7-1. Description of startup method

Method	Description
Create new configuration	Create new configuration file for device
Open configuration file	Open an existing configurations file
Read configurations from UAM	Read configurations from the connected UAM

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.7.1 Create new configuration

When the [Create new configurations] is selected, a window as shown in Figure 7-4 is displayed. User can enter the necessary information or read from the device and click [Next] to continue.

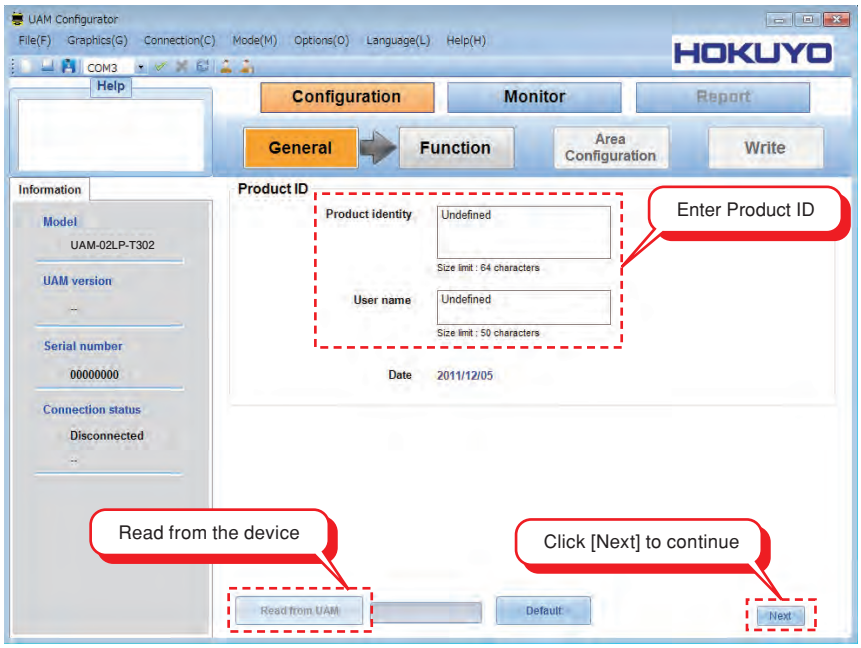


Figure 7-4. New configuration window

7.7.2 Open configuration file

When [Open configuration file] is selected, a window as shown in figure 7-5 is displayed. Select the related file and click [Open] to continue.

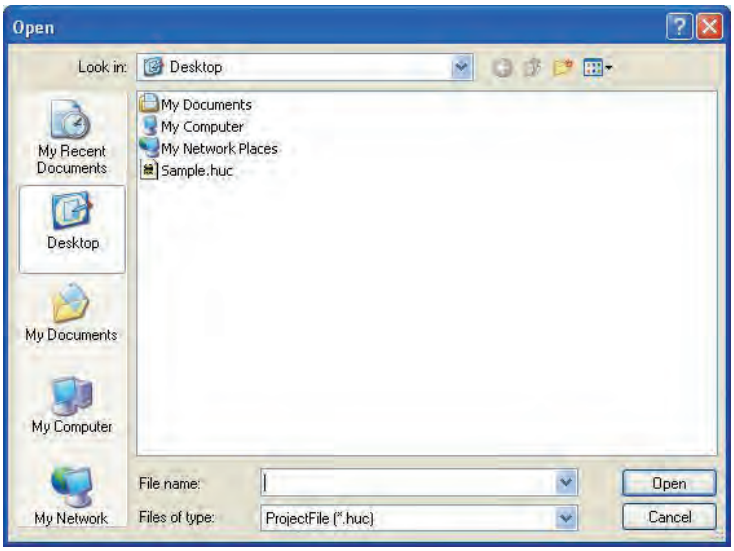


Figure 7-5. Open file

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.7.3 Read configuration from UAM

When [Read configuration from UAM] is selected, a window as shown in figure 7-6 is displayed indicating the information are being read from the UAM. When the settings are successfully read, Configurator will runs in monitoring mode.

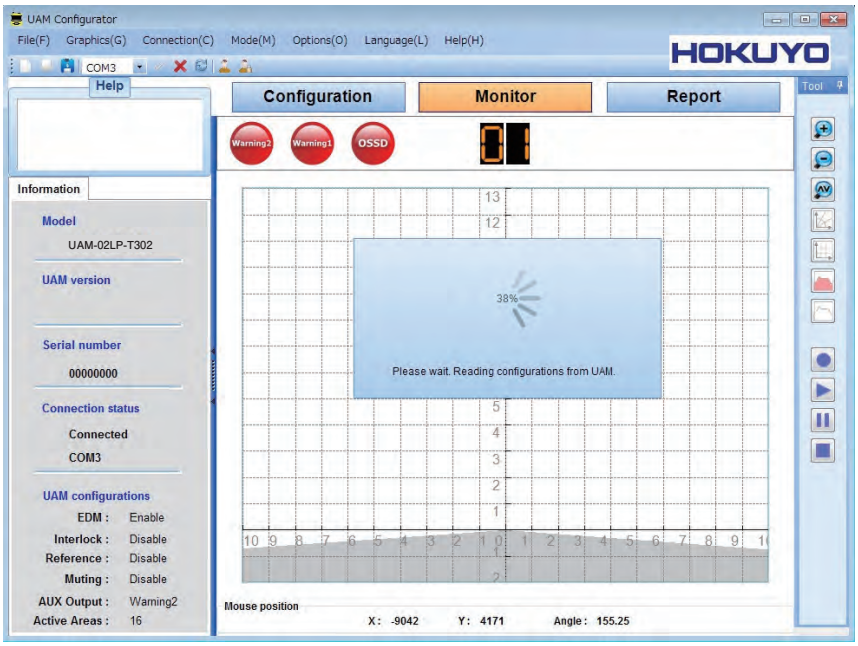


Figure 7-6. Read configurations window

7.8 Configurator components

Figure 7-7 below shows the name of each component of the main window.

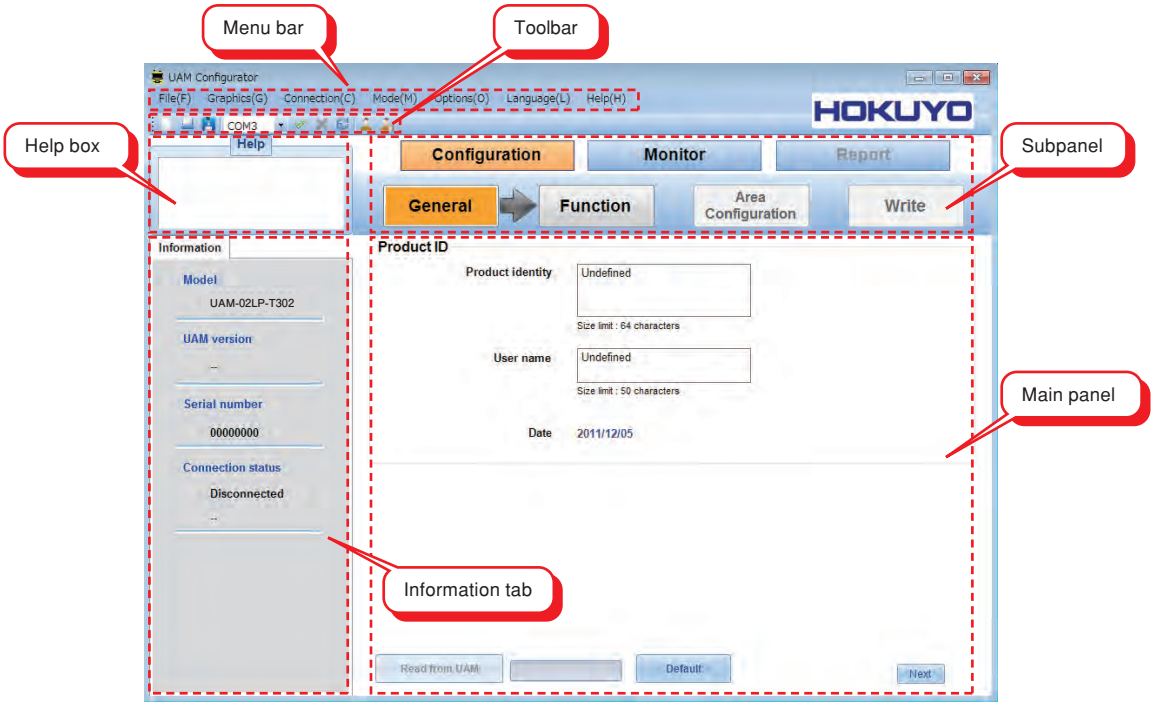


Figure 7-7. Components of Configurator

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.9 Menu bar

In this section, functions of the all the item in the menu bar is explained. Each function can be executed by clicking the respective function or by short-cut key.

7.9.1 File

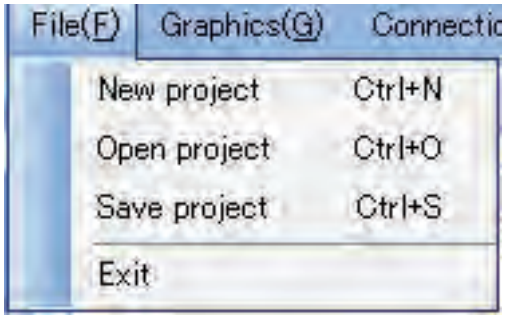


Figure 7-8. File menu

Table 7-2. File Menu

Item	Short-cut key	Function
New project	Ctrl + N	Creates a new project
Open Project	Ctrl + O	Open a saved project
Save project	Ctrl + S	Save the current project
Exit	——	Close the UAM Configurator

7.9.2 Graphics

Figure 7-9. Graphics menu

Table 7-3. Graphic menu

Item		Short-cut key	Function
Grid	Cartesian	——	Display grids in Cartesian unit (Figure7-9-1)
	Polar	——	Display grids in Polar unit (Figure 7-9-2)
Plot	Frame	——	Only the outline of the scanning area is displayed (Figure 7-9-3)
	Solid	——	Entire scanning area is displayed (Figure 7-9-4)
Zoom	Zoom up	Ctrl + Up	Closer view
	Zoom down	Ctrl + Down	Wider view
	Reset view	Ctrl + G	Reset the view to default setting

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

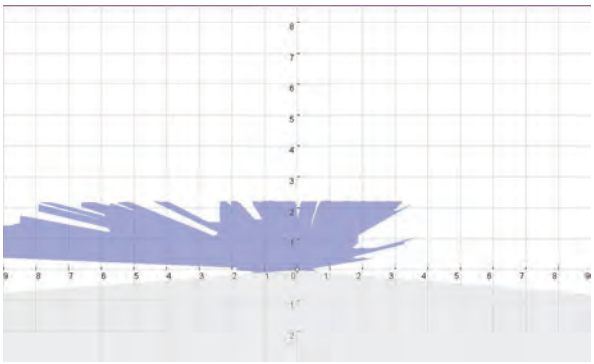


Figure 7-9-1. Cartesian

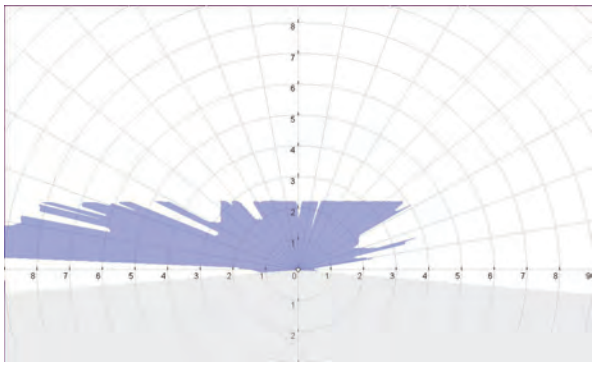


Figure 7-9-2. Polar

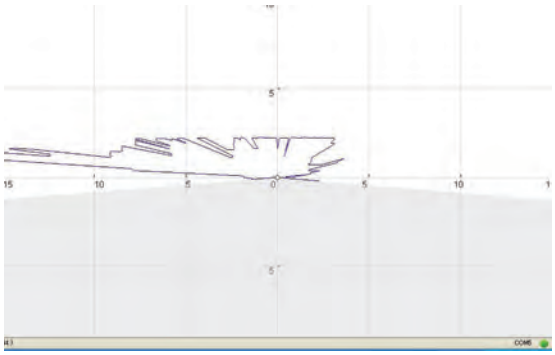


Figure 7-9-3. Frame

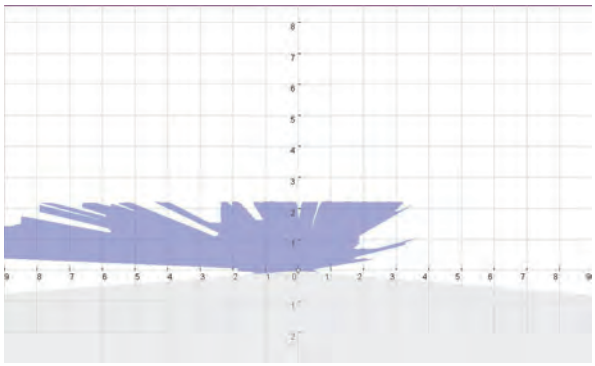


Figure 7-9-4. Solid

7.9.3 Connection

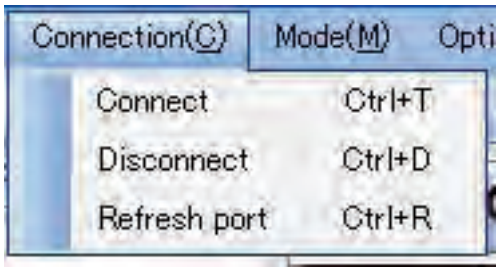


Figure 7-10. Connection menu

Table 7-4. Connection list

Item	Short-cut key	Function
Connect	Ctrl + T	Establish connection between PC and UAM
Disconnect	Ctrl + D	Disconnect connection between the PC and UAM
Refresh port	Ctrl + R	Refresh the port

7.9.4 Mode

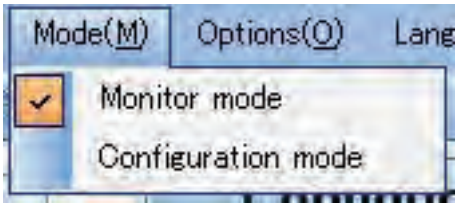


Figure 7-11. Mode menu

Table 7-5. Mode menu

Item	Short-cut key	Function
Monitor mode	——	Monitor the UAM operation.
Configuration mode	——	Configure UAM settings

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.9.5 Option

Figure 7-12. Option menu

Table 7-6. Option menu

Item	Short-cut key	Function
Wire Connection	——	Wire colour and function assignment (Figure 7-13)
Configurations clear	——	Clear UAM' s configurations back to default
Change Password	——	Change to new 8-digit numeric password

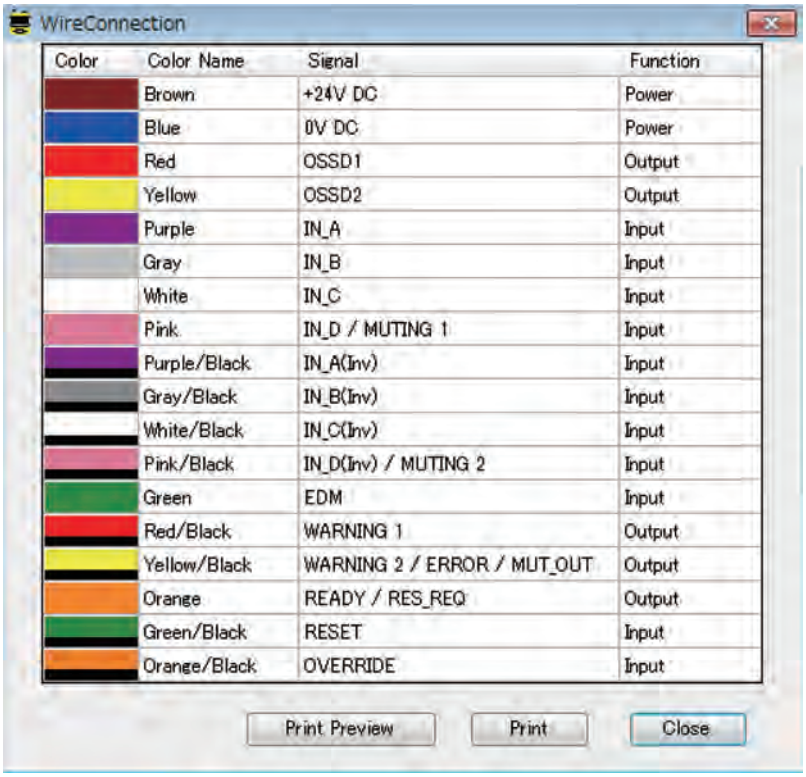


Figure 7-13. Wire colour and function assignment

When [Configurations clear] is clicked, all the configurations of the UAM will be cleared. After the configurations are cleared, operator is required to reconfigure the UAM to resume operation.

Note

- Operator is required to reconfigure the UAM after [Configurations clear] is clicked.
- UAM will not operate without configurations.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.9.6 Language

Figure 7-14. Language menu

Table 7-7. Language menu

Item	Short-cut key	Function
日本語	——	Display in Japanese language
English	——	Display in English language

7.9.7 Help

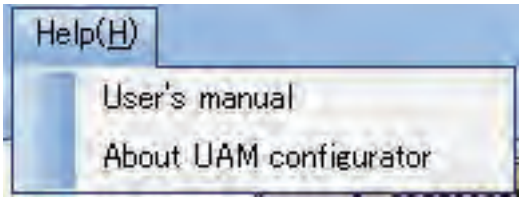


Figure 7-15. Help menu

User's manual* in PDF format is incorporated in the UAM Configurator application program. User can view this manual by clicking the [Help]→[User's manual] under the menu bar. [About UAM configurator] displays the details of the application program.

*The manual is in PDF format. Adobe Reader® or any equivalent application software is required to view the report. Free version of Adobe Reader® can be downloaded from the official website: http://www.adobe.com.

UAM Configurator
UAM Configurator
Version :
Warning : This application is protected by copyright law. Unauthorized reproduction or distribution of this program, or any portions of it, may result in severe penalties.
OK

Figure 7-16. UAM Configurator window

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.10 Toolbar

Icons of frequently used functions.

Table 7-8. Toolbar

Icon	Function
	Create new configuration file
	Open a saved setting file
	Saves the project file
	Port name/number connected to UAM
	Establishing connection between Configurator and UAM
	Disconnecting connection between Configurator and UAM
	Refresh the USB port
	Monitor mode
	Configuration mode

 All Rights Reserved

7.11 Subpanel

This subpanel is used to switch the modes (Configuration, Monitoring and Report).

7.11.1 Configuration tab

There are 4 tabs under the configuration tab (General, Function, Area configuration, and Write). User is required to configure the UAM through these 4 tabs in sequence.

7.11.1.1 General

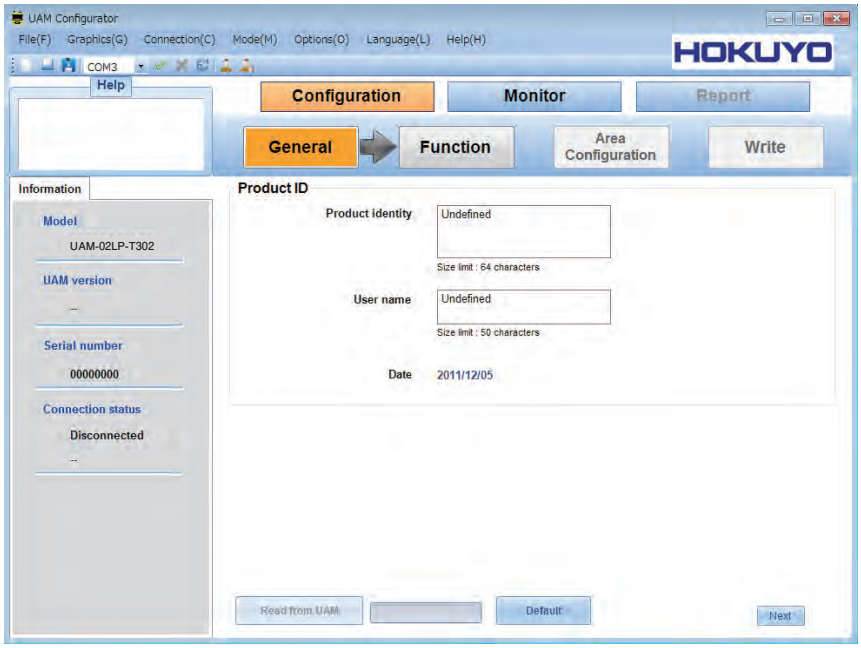


Figure 7-17. General

Tab	Item	Description
General	Product identity	Enter ID for UAM (Limit to 64 characters)
	User name	Enter User name (Limit to 50 characters)

7.11.1.2 Function

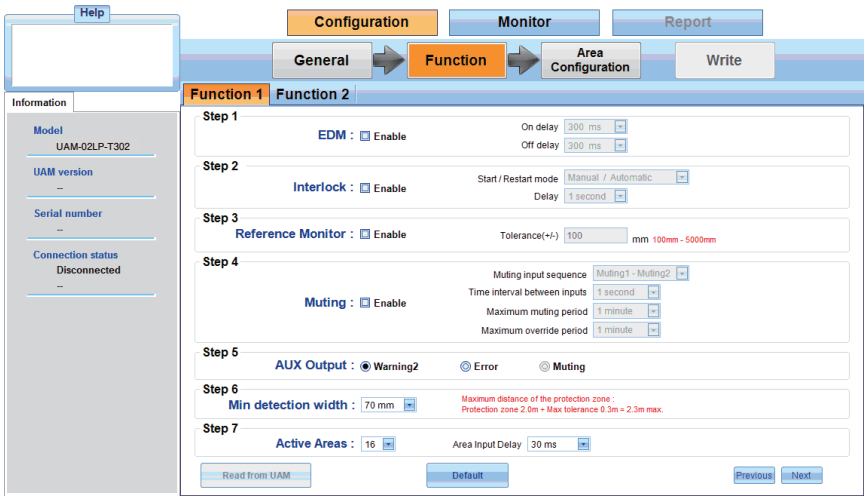


Figure 7-18 (a). Function1

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

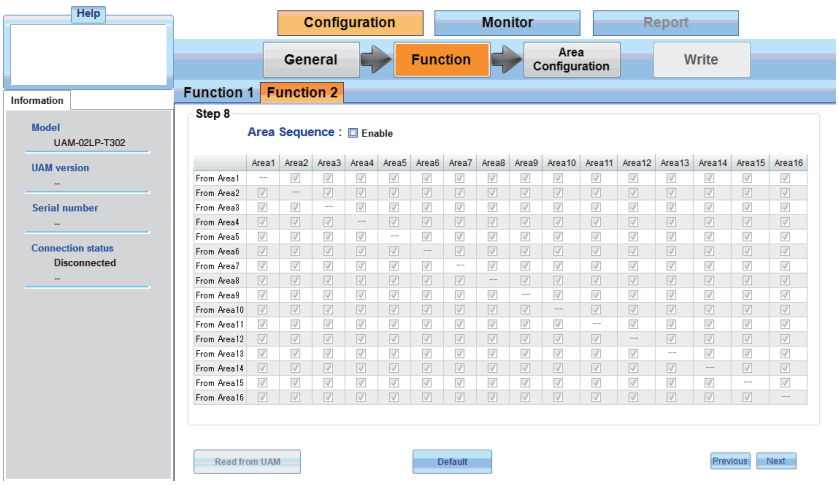


Figure 7-18 (b). Function2

Tab	Item	Description
Function1	EDM	Click to enable the EDM function ● On delay(ms): 300 (Default), 330, 360 ● Off delay(ms): 90, 120, 300 (Default)
	Interlock	Click to enable the Interlock function ● Start/Restart mode: Manual/Automatic, Manual/Manual ● Delay(s): 1(Default) - 6
	Reference monitor	Click to enable the Reference monitor function ● Tolerance(mm): 100 (Default)
	Muting	Click to enable the Muting function ● Muting input sequence: Muting 1 → Muting 2 (Default), Muting 2 → Muting 1 ● Time difference between inputs(s): 1(Default), 3, 5, 10 ● Max. muting period(min): 1(Default), 6, 12 ● Max. override period(min): 1(Default), 6,12
	AUX Output*1	Click to assign the related output signal ● Warning2 (Default) ● Error ● Muting (Only active when muting is activated)
	Detection width*2	Click to configure the minimum of detection object width. ● Min. width(mm): 30, 50, 70 (Default)
	Active areas*3	Click to configure number of areas to be used and switch delay ● Active area: 1-16, 1–8(Muting) ● Area switch delay: 30ms (Default), 120ms, 270ms, 970ms, 1970ms
Function2	Area sequence*4	Click to enable area sequence function and configure the sequence table. ● Area sequence table (See the setting example).

*1: Only one output signal can be assign to the AUX output at one time

*2: Minimum width of the object intended to be detected. Object might not be detected if the minimum width configured is bigger than the object width.

*3: Configure the number of areas intended to use. Wiring of Area input signal should be done according to the active areas. If the area input signal exceeds the configured active areas, it will be detected as error.

*4: All active areas must have at least one area sequence selected. Put checkmark in the box to select the sequence.
This function cannot be used if active area is 1.
Sensor version is 2.0.0 does not have area sequence function.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

＜Example of setting＞

Fig 7.18(c) shows the setting example of area sequence for three active areas and sequence is area1→area2→area3→area1.

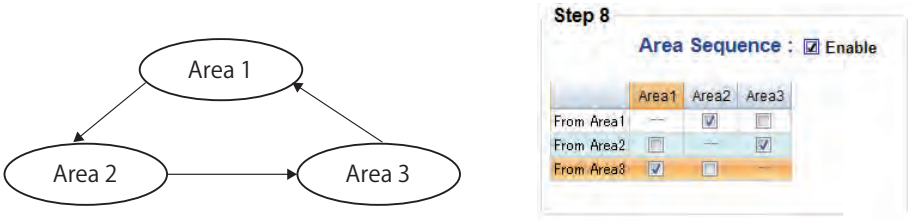


Figure 7-18(c). Setting example of area sequence function

7.11.1.3 Area configuration

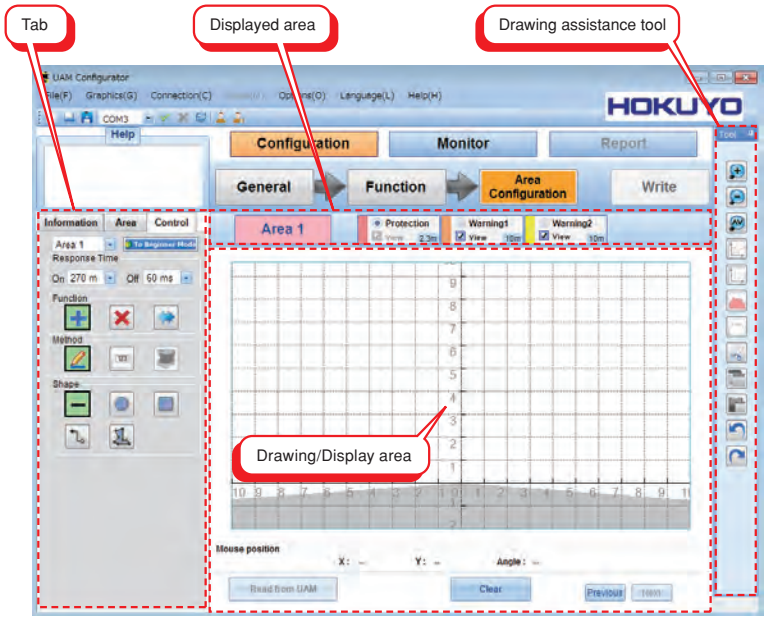
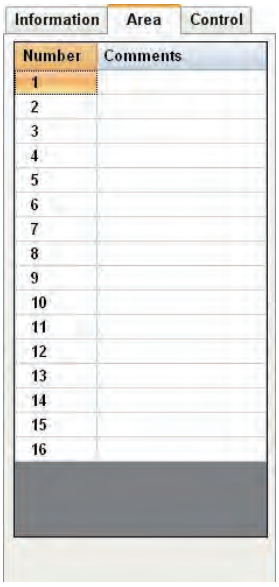


Figure 7-19. Area setting

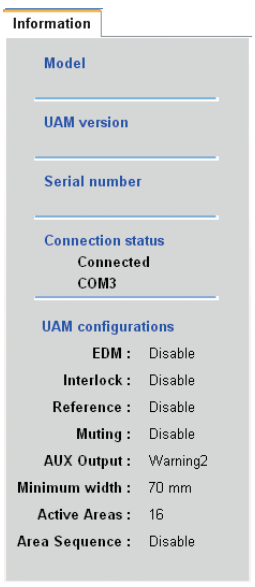
7.11.1.4 Area configuration tab

There are 3 tabs when [Area configuration] is selected, namely [Control], [Area] and [Information]

(a) Control



(b) Area



(c) Information

Figure 7-20. Area configuration tab

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Tab	Item	Description
Control	Area1	Select area to display or edit
	To Beginner Mode	When this is clicked, a step-by-step instructional guide will lead user in configuring the UAM
	Response time	Set the response time of the selected area ● On(ms): 270 – 510 ● Off(ms): 60 – 510
	Function	: Add : Delete : Create mirror image
	Method	: Draw area graphically : Numerical input : Teaching
	Shape	: Line : Circle : Rectangle : Select single point : Select multipoint
	Numerical input	This will be activated when the [Numerical input] drawing method or [Teaching] is selected.
Area	Number	Number of the area
	Comment	User can enter related comment for respective area
Information	Model	UAM model
	Sensor version	UAM version
	Serial number	Serial number of the connected UAM
	Connection status	Connection between Configurator and UAM

7.11.1.5 Displayed zone

(a) UAM is connected

(b) UAM is disconnected

Figure 7-21. Displayed zone

Zone selected is indicated in this displayed area panel. User can also hide the respective zones by unchecking the zone. Connection of the UAM is indicated by the colour of the "Area" icon. Green represents connected while pink represents disconnected state.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.11.1.6 Drawing assistance tool

Drawing assistance tools for zone configuration.

Icon	Function
	Zoom up
	Zoom down
	Reset view
	Polar grid
	Cartesian grid
	Solid
	Frame
	Cut
	Copy
	Paste
	Undo
	Redo

7.11.1.7 Write

Once the configuration is complete, user can write it to the UAM. All the configured parameters will be displayed for re-confirmation. Figure 7-22 shows the [Write] tab for re-confirmation before being write into the UAM.

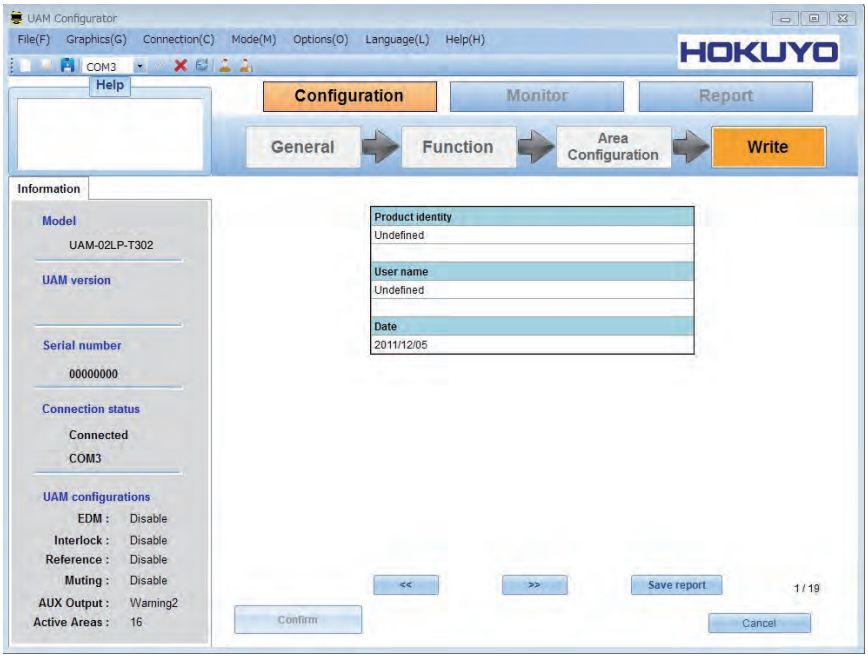


Figure 7-22. Write

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.11.2 Monitor tab

User can monitor the detection state of the UAM in real time by selecting the monitor tab.

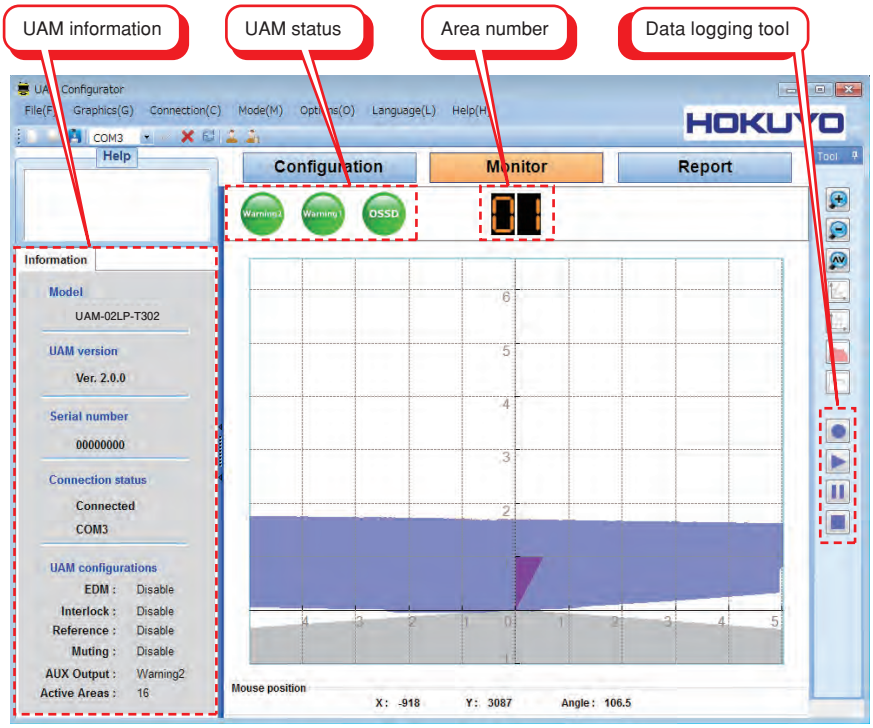


Figure 7-23. Monitor tab

Tab	Item	Description
UAM status		OSSD state Green button: OSSD ON Red button: OSSD OFF
		Error is detected
		Cleaning is needed for the optical window
		UAM is in lockout state.
		UAM is in muting state
		UAM is waiting for the reset signal to resume operation
		WARNING 1 state Green button: Warning ON Red button: Warning OFF
		WARNING 2 state Green button: Warning ON Red button: Warning OFF
Area number		Area number is displayed (During operation) Error number is displayed when UAM is stopped

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Data logging	●	Start recording
	▶	Play the recorded data
	❚❚	Pause
	■	Stop
Information	Model	UAM model
	UAM version	UAM version number
	Serial number	Serial number of the connected UAM
	Connection status	Connection status between Configurator and UAM
	UAM configurations	Configured sensor settings

7.11.3 Report tab

This tab is only functional when the UAM is connected to the Configurator. There are 2 types of reports, UAM report and error report. UAM report includes the UAM's configurations. Error report includes error recorded during the operation and also lockout's error.

User can save this report* in PDF format by clicking the [Save report] button on the report tab. Items included in the report are shown in the table below.

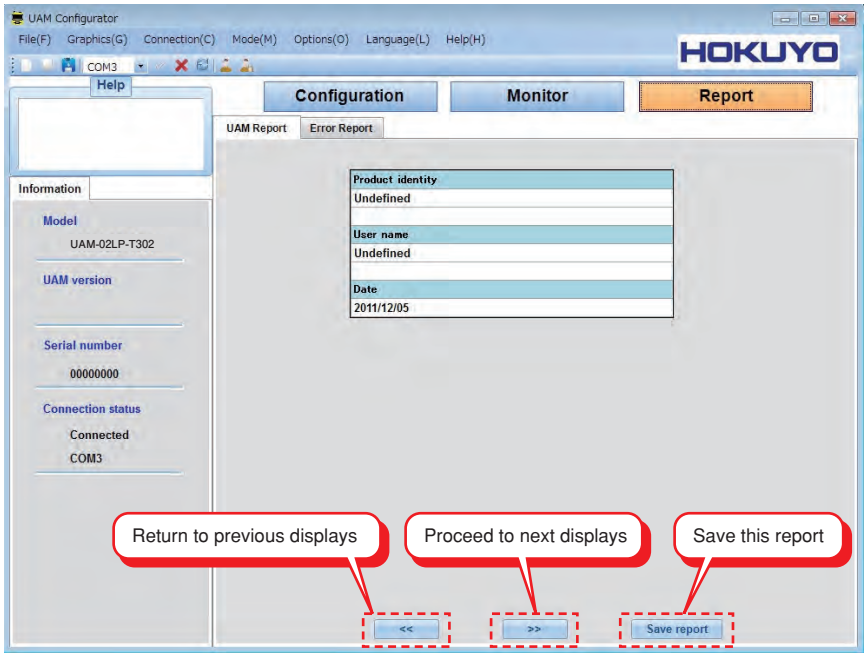


Figure 7-24(a). UAM report

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

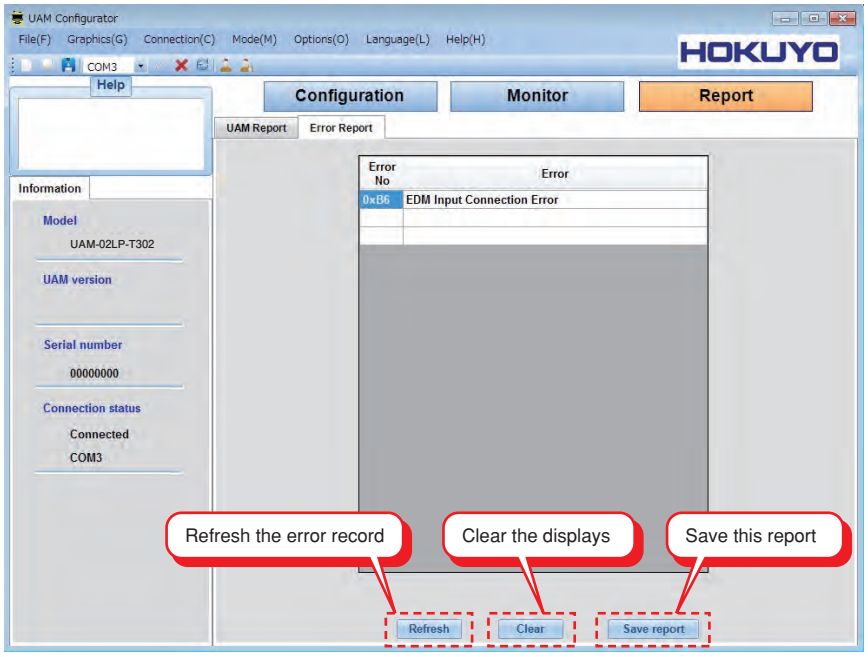


Figure 7-24(b). Error report

Report	Items show in report
UAM	● Product identity ● User name ● Date ● EDM ● Interlock ● Reference monitor ● Muting ● AUX Output ● Minimum detection width ● Active areas ● Area sequence ● Areas configured by user
Error	Error report includes error recorded during the operation and also lockout's error.

* The report is generated in PDF format. Adobe Reader® or any equivalent application software is required to view the report. Free version of Adobe Reader® can be downloaded from the official website: http://www.adobe.com

* Report generated is in English

 All Rights Reserved

7.12 Connecting the UAM with PC

a) Plug-in the USB cable into both UAM and PC.

b) If the UAM is not detected automatically after plugged in, click the [Connect] ✔ icon on the toolbar or press "Ctrl + T" to establish the connection.

c) Click [Refresh] icon on the toolbar or press "Ctrl + R" for port refresh.

d) Connection status is shown at the information tab. When the UAM is successfully connected, [Connected] is shown with port number connecting the UAM as shown in figure 7-25.

e) When the UAM is disconnected, [Disconnected] is shown. No port number will be displayed. Figure 7-26 shown the information tab when the UAM is disconnected.

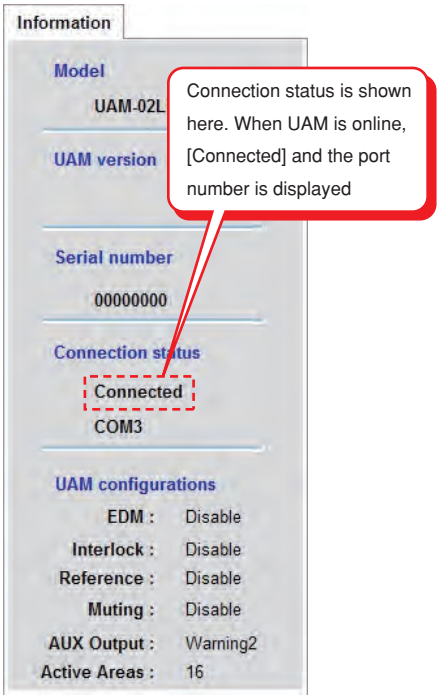


Figure 7-25. Connected

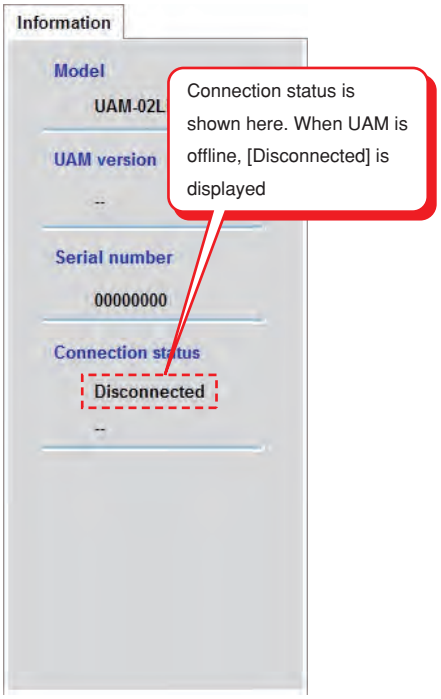


Figure 7-26. Disconnected

Note

- Use of USB hub should be avoided.
- If the UAM is not detected after plugged in to the PC, click the refresh button.
- If additional UAM is plugged in to the same PC, click the refresh button in order to list the USB port.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.13 Password

Configuration of the UAM is password protected. User is required to enter the password in order to proceed to the configuration. When a window as shown in figure 7-27 is displayed, key-in the password and click [Login] to proceed.

Default password is [12345678].

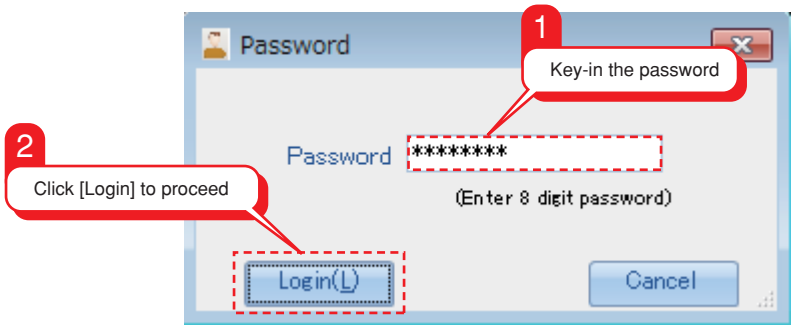


Figure 7-27. Password Window

7.13.1 Changing password

User can change the password by the following steps:

a) Click the [Option] on the menu bar

b) Click the [Change password]

c) A window as shown in figure 7-28 will be displayed.

d) Key-in the new password and retype the new password for confirmation. The new password should consist of 8 numerical digits

e) Click [OK] to complete the operation

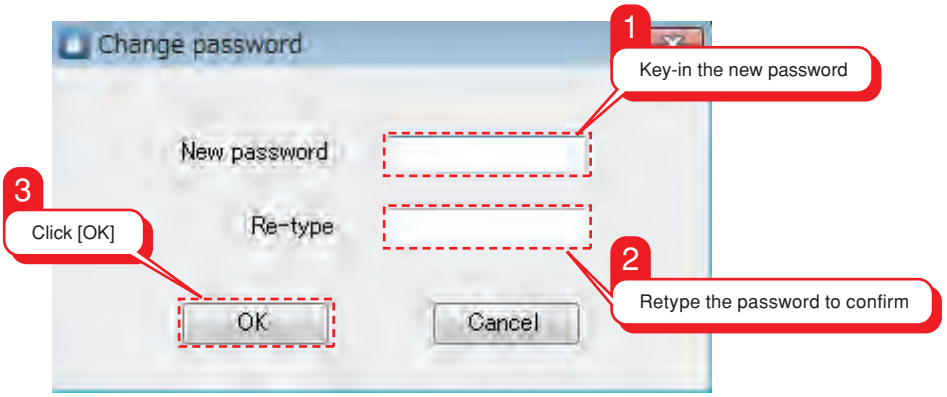


Figure 7-28. Change Password Window

7.13.2 Reclaim forgotten password

If password is forgotten, follow these steps to reclaim the password.

a) Click the [File] on the menu bar

b) Click the [Save project] or press Ctrl + S, save the project at a preferred location. A file [*****.huc] is saved.

c) Send this [****.huc] file to the nearest office or representative listed on chapter 11 to reclaim the forgotten password.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.14 Configuration mode

To configure the UAM, click on the [Configuration] tab. UAM configuration is password protected. User is required to log-in with password before proceeding with the configuration to prevent unauthorized access. Refer to chapter 7.13 for details on password.

To connect the UAM for configuration, follow the steps below:

a) Make sure the connection between UAM and PC is connected (Refer to 7.12).

b) Click on the [Configuration] tab or [Configuration mode] button at the toolbar .

c) A password window will be displayed requesting for password (Figure7-29). Key-in the password.

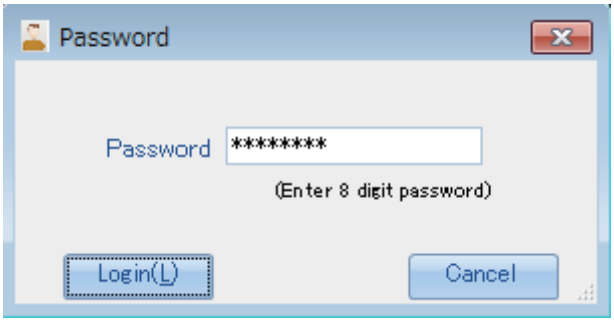


Figure 7-29. Password Window

d) [General] tab will be displayed. If not, user can click on the [General] tab. Type-in the product identity and username. These information will be printed on the report generated by the Configurator. Refer to chapter 7.11.3 for details on report.

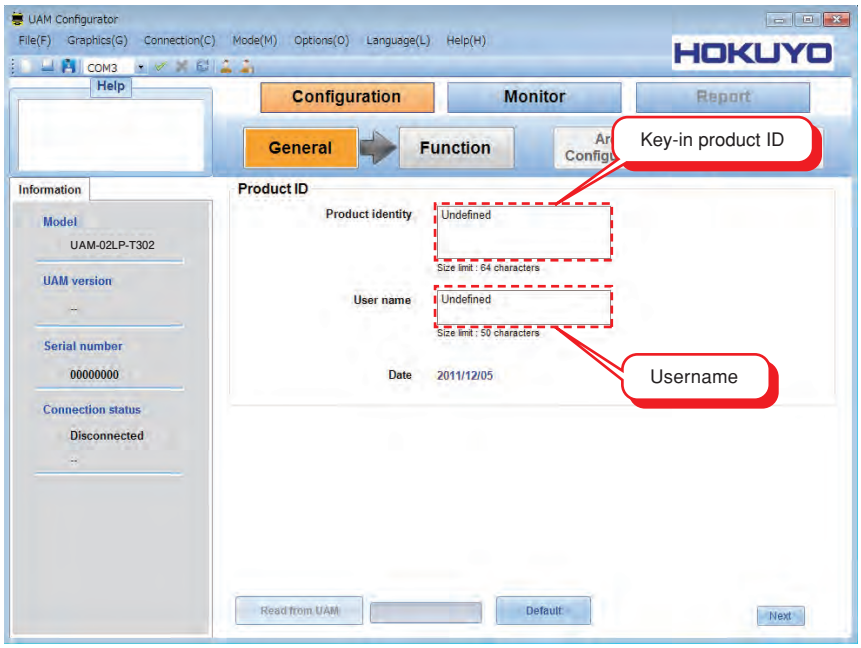


Figure 7-30. Configuration

Note ● OSSD remain in OFF-state when UAM is under configuration mode.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.15 Function configuration

User can configure various functions of the UAM through this Configurator. Click on the [Function] tab and a list of the configurable functions will be displayed as shown in figure 7-31. Click on the [Enable] box to activate those functions. Refer to chapter 7.11.1.2 for details on these functions.

Configurable functions are as follows.

a) EDM

b) Interlock

c) Reference monitor

d) Muting

e) AUX Output

f) Minimum detection width

g) Active area

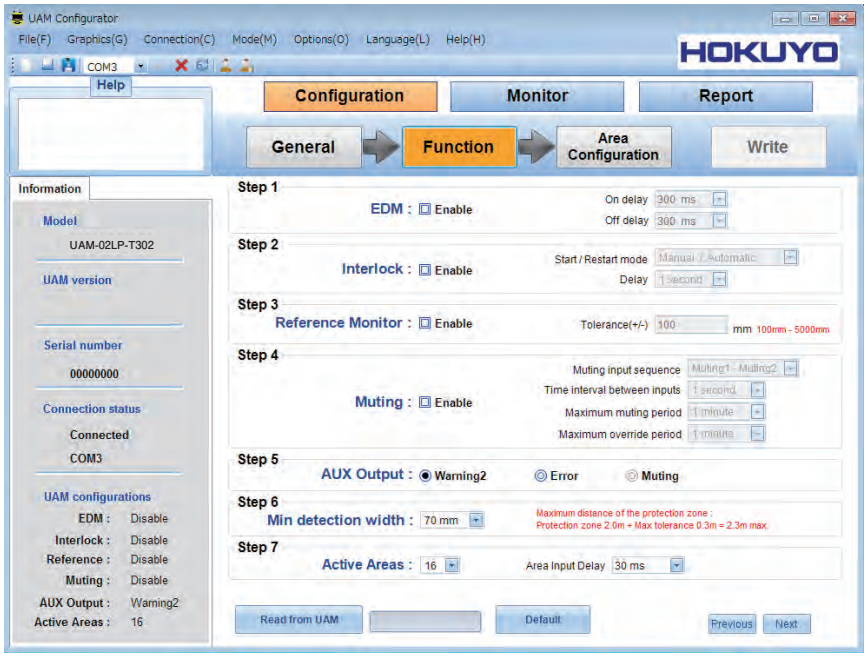


Figure 7-31. Function configuration

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16 Zone configuration

There are 3 methods for zone configuration, drawing tools, numerical input and teaching method. Besides, user can also configure reference boundary segment and muting zone using these methods.

Steps to be performed before performing the zone configuration are as follows.

a) Make sure the connection between UAM and PC is connected (Refer to 7.12).

b) Click on the [Configuration] tab or [Configuration mode] button at the toolbar and a password window will be displayed requesting for password (Figure7-32). Key-in the password.

Figure 7-32. Password Window

c) After the user has successfully logged in, UAM will switch to Configuration mode automatically. OSSD signal will switch to OFF-state during Configuration mode.

d) Click the [General] tab and key in the necessary information.

e) Click the [Function] tab and configure the necessary functions.

f) Click on the [Area Configuration] tab and select the area for configuration. (Ex.: Protection, Warning 1 or Warning 2).

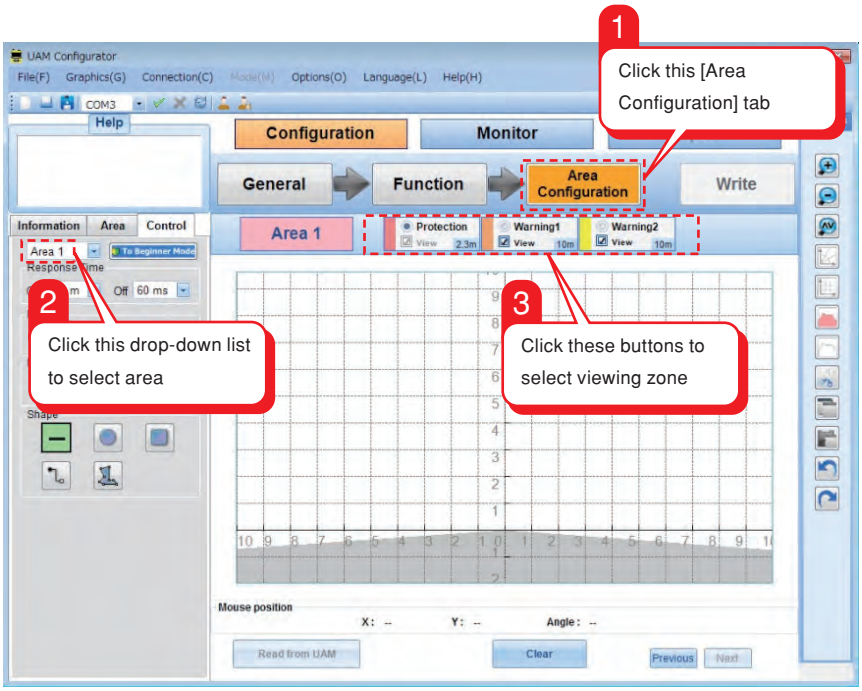


Figure 7-33. Area selection

Note ● Right-click the mouse to move the drawing area.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.1 Zone configuration by drawing tools

Zone can be configured using the drawing tools of the UAM Configurator. Steps below explains zone configuration using the [Draw] drawing tool.

A step-by-step instructional guide is available by clicking the [Step-by-step guide] To Beginner Mode button.

a) Click on the [Draw] button.

b) Select the drawing shape.

c) Move the cursor on to the drawing area, drag-drop to draw the zone.

d) For other area configuration, select the respective area and repeat the above steps to configure other areas.

e) Zone points can be manipulated individually or in group. For individual point manipulation, click the [Single point] button. For multipoint manipulation, click the [Multipoint] button and select a group of points for manipulation.

f) To create identical zone, click on the [Mirror] button.

g) To delete the entire zone, click the [Cut] button.

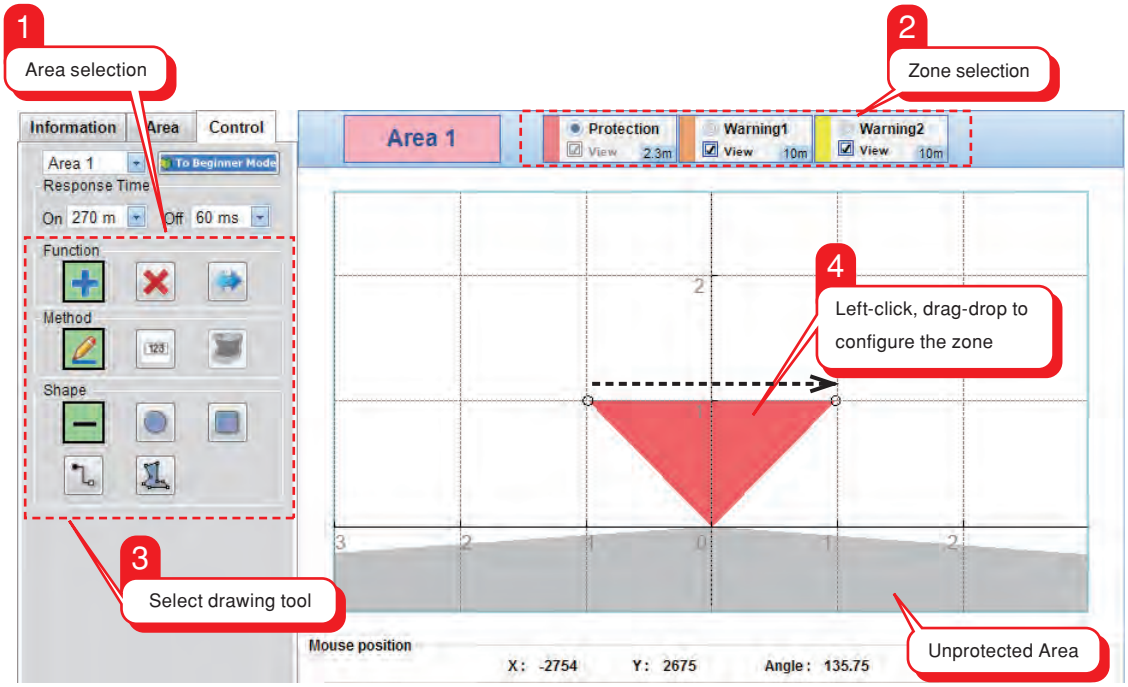


Figure 7-34. Zone configuration by drawing tool

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.2 Zone configuration by numeric input

Zone configuration by numeric value is important especially for zones that requires accuracy. Steps below explains zone configuration by numeric input using the [Circle] drawing tool. Same procedures are applicable for other drawing tools.

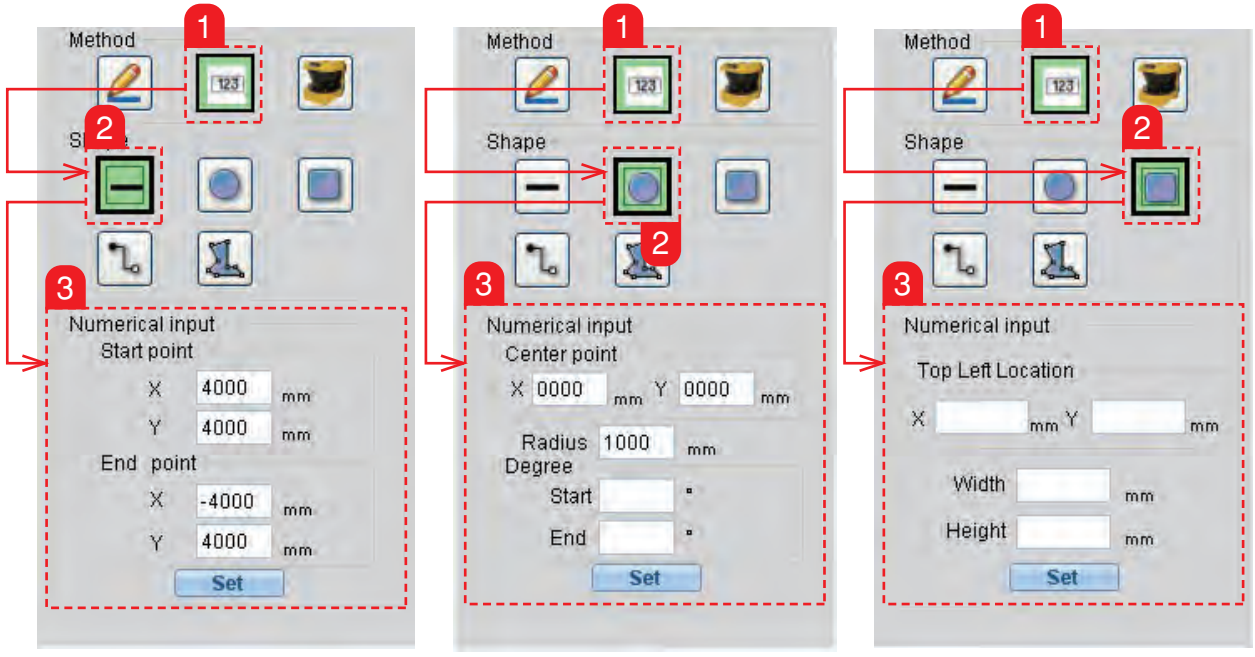
a) Click on the [Numeric input] button for numeric input. This will activate the numeric input boxes.

b) Click on the [Circle] button or other drawing tool. The numeric input boxes will change accordingly to the selected drawing tool. Different drawing tool required different parameters. Figure 7-35 shows the different parameters of the various drawing tool.

c) Enter in the respective numeric values in millimeter (mm).

d) Click the [Set] button after the all the parameters are key-in. The area will be drawn according to the parameters.

e) Zone points can be manipulated individually or in group. For individual point manipulation, click the [Single point] drawing tool. For multipoint manipulation, click the [Multipoint] drawing tool.



(a) Line (b) Circle (c) Rectangle

Figure 7-35. Numeric input

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.2.1 Single point manipulation

After the area is configured, user can manipulate each area point by clicking the [Single point] drawing tool button. User can add area point to the configured area, or move single area point using this drawing tool.

To add additional area point:

a) Click the [Single point] button

b) Enter the X and Y coordinate of the new area point

c) Select [New Point]

d) Click [Set] to add the new area point

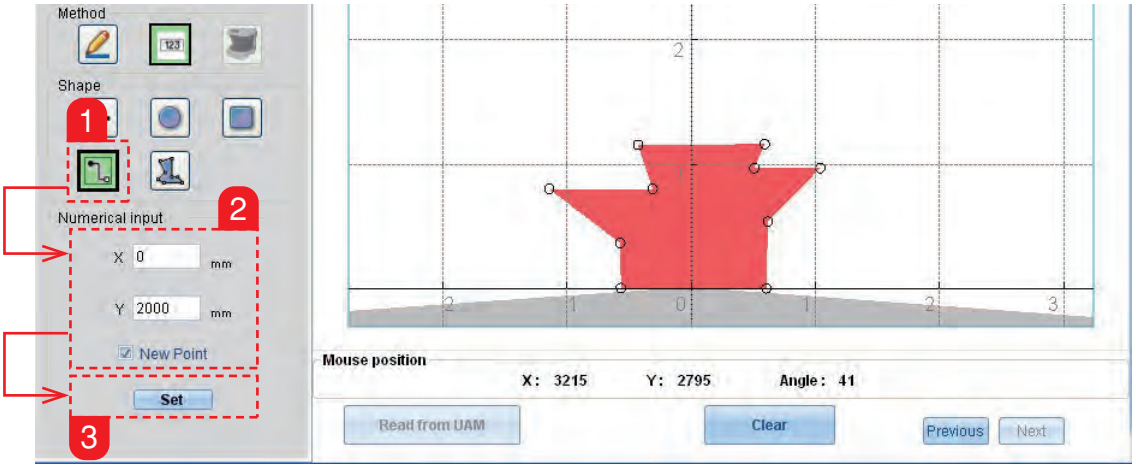
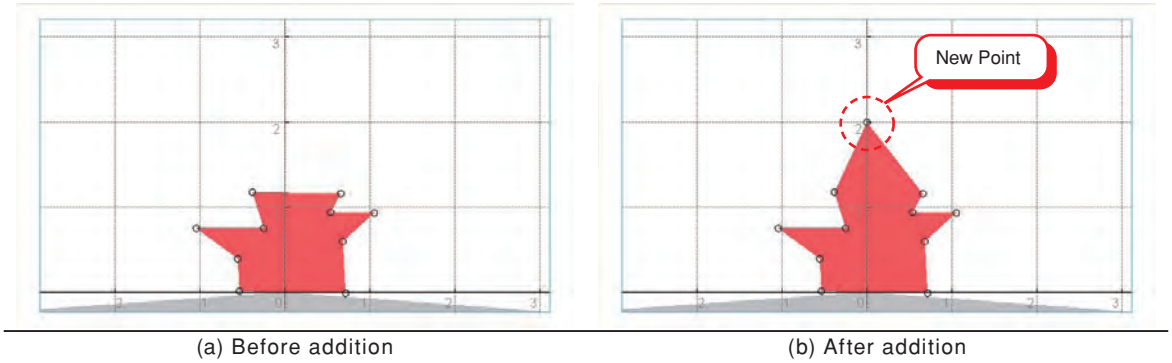


Figure 7-36. Addition of single point

Figure 7-37 below shows the addition of single point at (0, 2000).



(a) Before addition (b) After addition

Figure 7-37. Addition of single point

To move a single point:

a) Click the [Single point] button

b) Unselect the [New Point] if its is selected

c) Select a point for manipulation. The X and Y coordinate of the selected point will be displayed. Selected point will be displayed in blue colour

d) Enter the X and Y coordinate for new location

e) Click [Set] to move the selected point

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

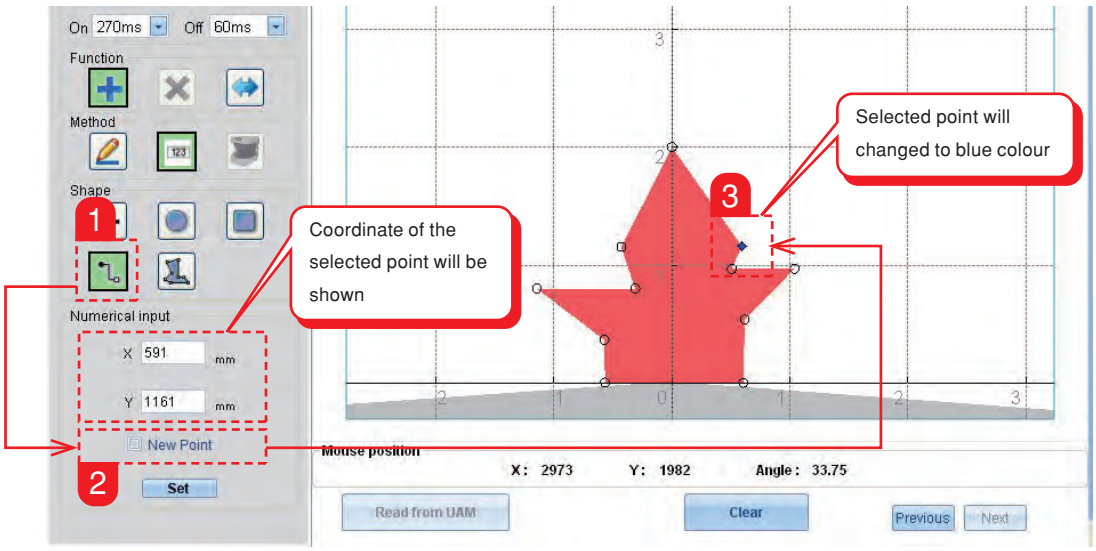


Figure 7-38. Moving single point

Figure 7-39 below shows the point (658, 1163) being moved to (1000, 2000)

Figure 7-39 (a). Before moving

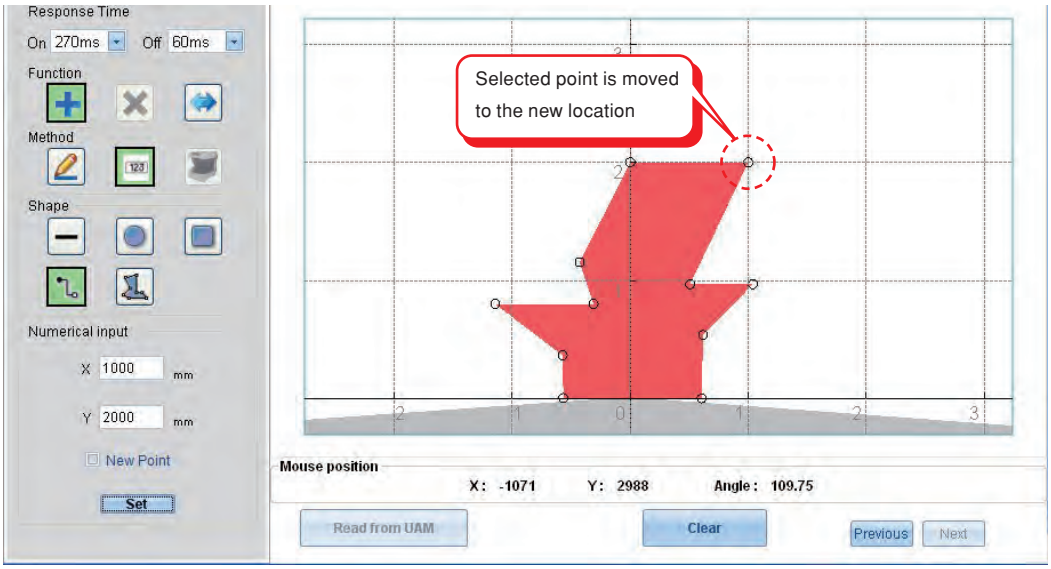


Figure 7-39 (b). After moving

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.2.2 Multipoint manipulation

After the area is configured, user can manipulate the entire or portion of the configured area by clicking the [Multipoint] drawing tool button.

Move multipoint by offset:

a) Click the [Multipoint] drawing tool button

b) Drag-drop to select group of points. Selected point will be changed into blue colour

c) Enter the offset value in the range of -99% to 100%

d) Click [Set] to offset the selected area points

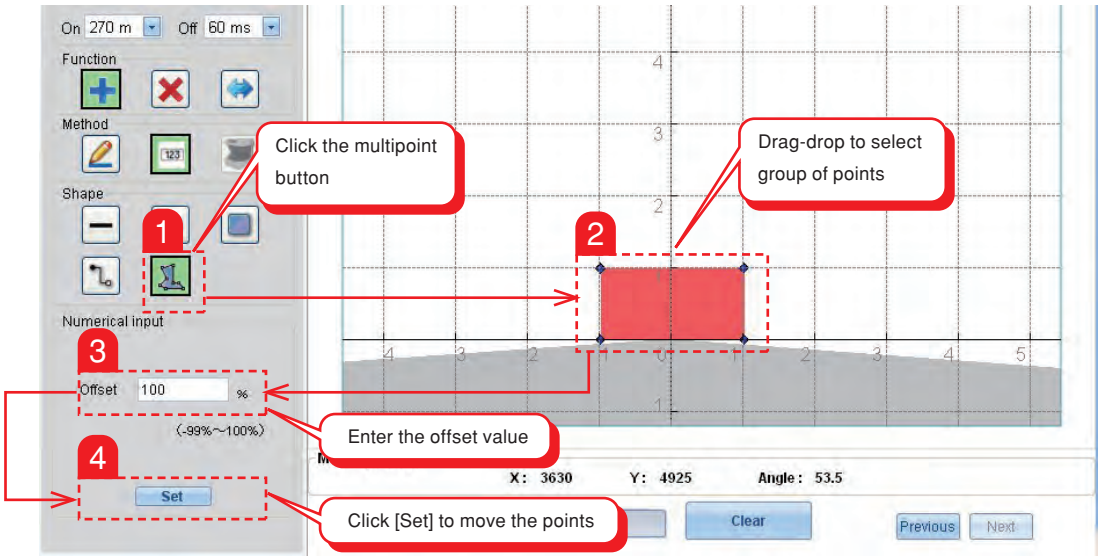


Figure 7-40. Moving multipoint

Figure 7-41 below shows the multipoint manipulation

(a) Before offset (b) After offset

Figure 7-41. Offset the selected points

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.3 Zone configuration by Teaching function

Zone configuration can be done automatically by using the [Teaching] function by referring to static guards/ boundary/wall surrounding the UAM. This function is useful when user needs to configure complex zone or would like to reduce the time required for zone configuration. Steps below show the procedures for using the [Teaching] function.

a) Ensure the UAM is connected with the PC.

b) Click on the [Teaching] button.

c) Key-in the respective parameters, corridor size. (Figure 7-42).

d) Corridor size must be in the range of 100 – 700mm. A warning message will be displayed if the value keyed in is out of this range.

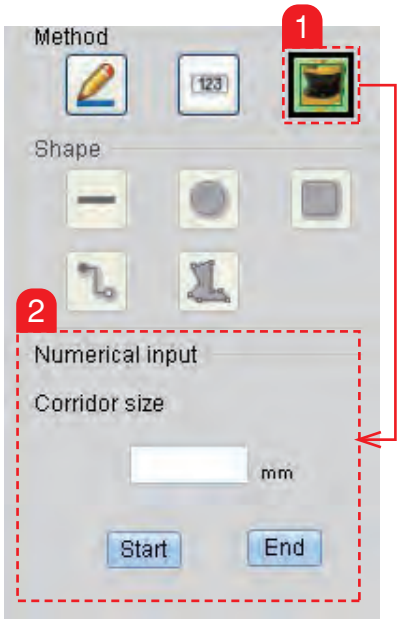


Figure 7-42. Teaching parameter

e) Click [Start] to enable the automatic zone configuration. Click [End] to terminate the automatic zone configuration. Surrounding boundaries are detected and will be shown including the corridor size (Figure 7-43).

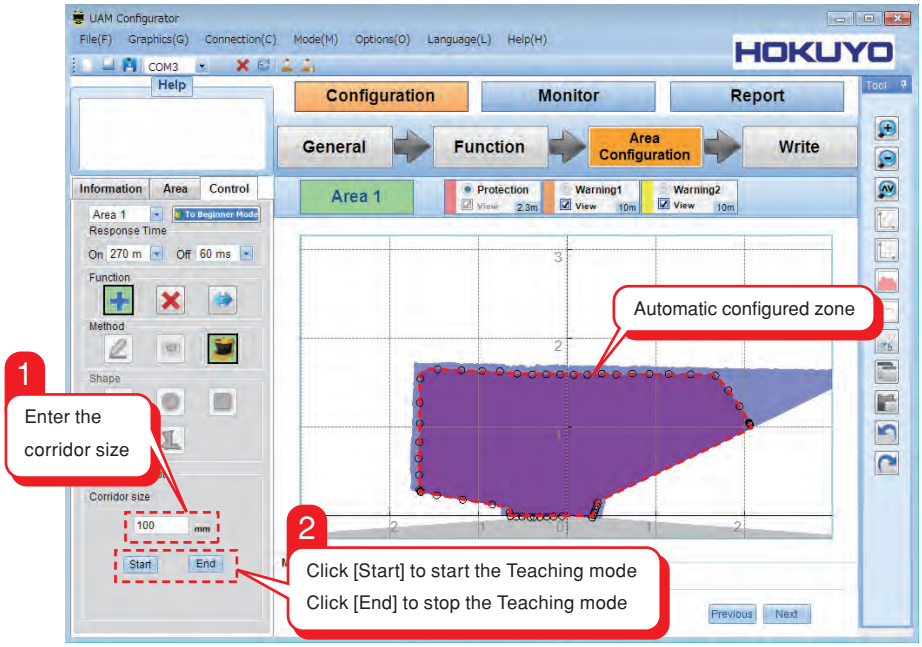


Figure 7-43. Teaching

f) After the area is configured, it can be edited using the drawing tools.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

Danger

- User must verify the configured zones before writing to UAM as the automatic configured zones could differ from the area user intended to protect.
- The corridor size must be in the range of 100 – 700mm.
- Failure in doing this could result in hazardous area being unprotected and leads to critical injury and death.

Note

- When there is no boundary beyond the maximum distance, the zone will be configured at the maximum distance of the UAM.

7.16.4 Reference monitoring configuration

This function must be enabled when UAM is used for vertical applications. Follow the steps below to configure reference monitoring function.

a) Ensure the UAM is firmly mounted at its location.

b) Ensure the connection between UAM and Configurator is established.

c) Click the [Function] tab and enabled [Reference Monitor], enter the required tolerance distance.

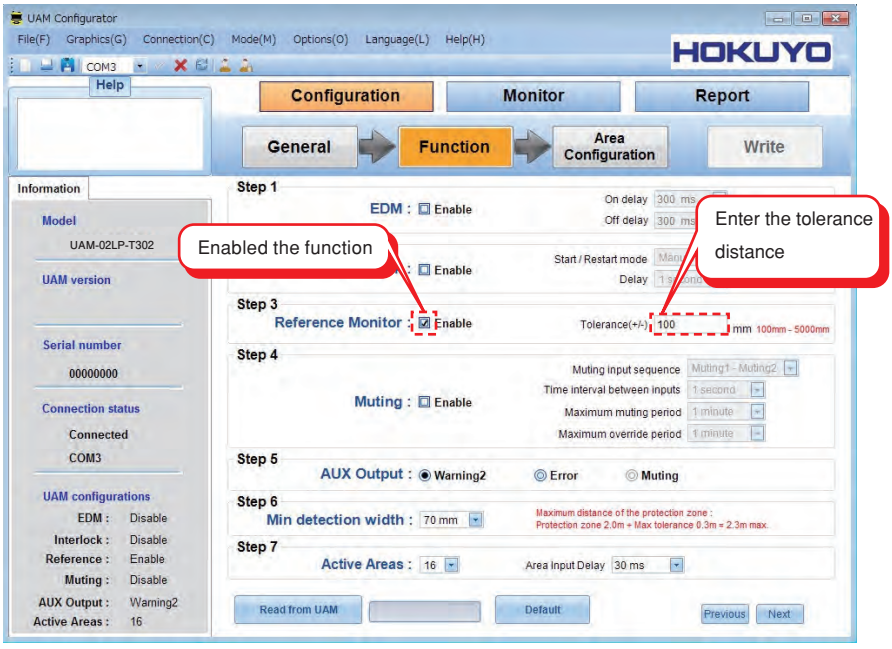


Figure 7-44. Activate Reference Monitor function

d) Configure other functions if necessary.

e) Click [Area configuration] or [Next] to proceed.

f) After the Reference monitor function is enabled, [Reference] will be shown on the [Displayed Area] panel as shown in figure 7-45 to configure reference segment.

Figure 7-45. Select Reference segment

 All Rights Reserved

g) Select the [Reference] and configure the reference segment using the drawing tool. Move the cursor on the drawing area, drag-drop to draw the segment.

h) The tolerance will be configured as shown in figure 7-46. Added tolerance is displayed in green colour.

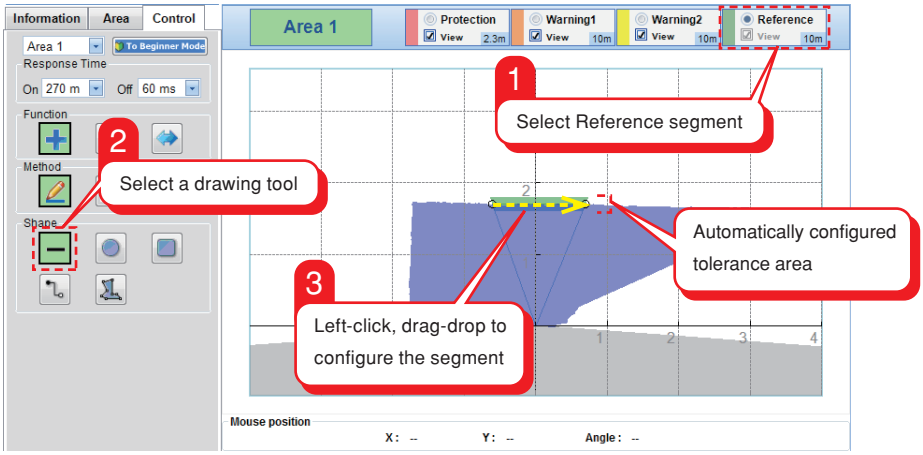


Figure 7-46. Reference segment configuration

i) Ensure the reference segment is correctly configured.

j) Click [Next] button or [Write] tab and to write the configured area into the UAM.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.5 Muting configuration

This function is used to temporarily suspend safety functions of UAM when required conditions are fulfilled. Follow the steps below to configure this function.

a) Ensure the connection between UAM and Configurator is established.

b) Click the [Function] tab and enable [Muting], enter the required parameters.

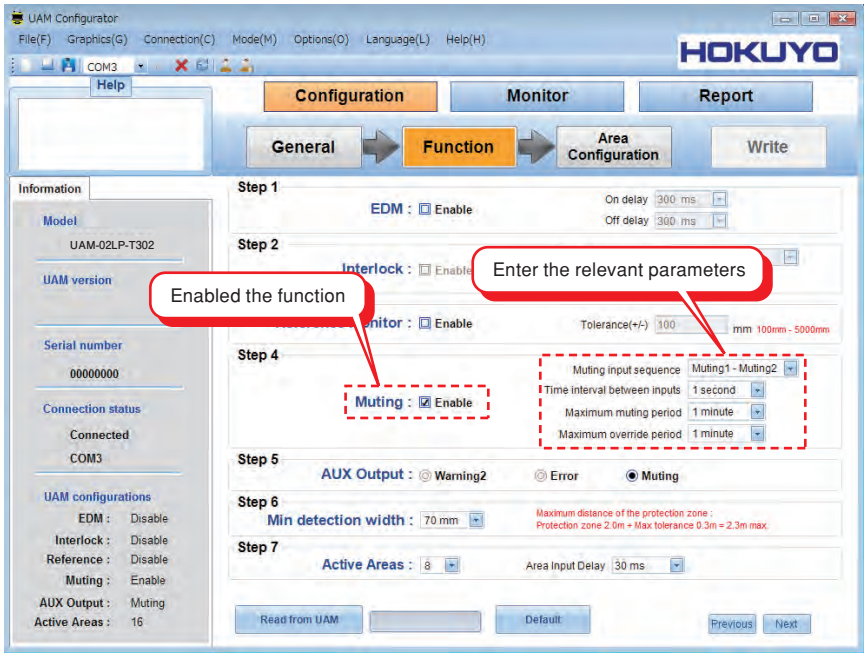


Figure 7-47. Activate Muting function

c) Click [Area configuration] or [Next] to proceed.

d) After the Muting function is enabled, [Muting] will be shown on the [Displayed Area] panel as shown in figure 7-48 to configure muting zone.

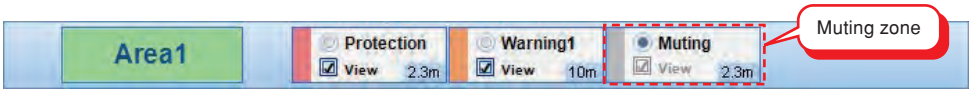


Figure 7-48. Select muting area

e) Select the [Protection] for muting zone configuration.

f) Select the [Muting] on the displayed zone panel and configure the muting zone using the drawing tool. Move the cursor on to the drawing area, drag-drop to draw the zone.

g) Muting zone is displayed in purple colour as shown in figure 7-49.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

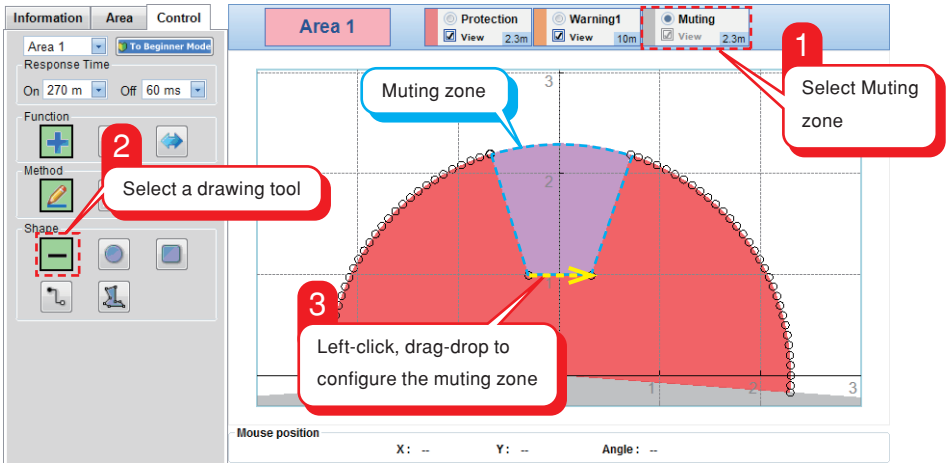


Figure 7-49. Muting zone configuration

h) Ensure the muting zone is correctly configured.

i) Click [Next] button or [Write] tab and to write the configured zones into the UAM.

Note

- When Muting function is enabled, the AUX output will be automatically configure as muting output.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.16.6 Writing configurations into UAM

Once the area and functions configuration are completed, it is necessary to write these configurations into the UAM. UAM will operate with previous configurations unless the new configurations are successfully written. Writing steps are as follows.

a) Click the [Write] tab as shown in figure 7-50.

b) A window requesting for confirmation as shown in figure 7-50 will be displayed.

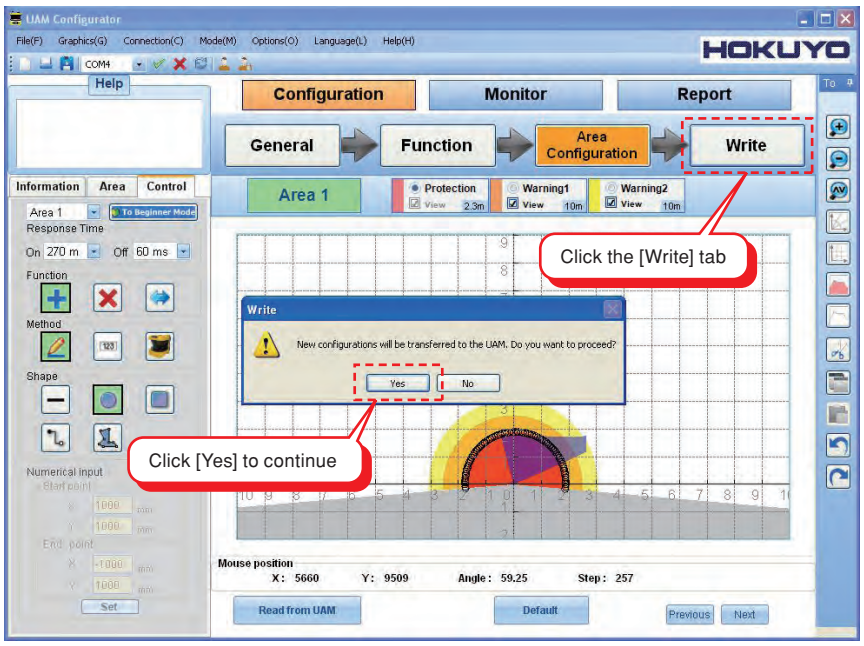


Figure 7-50. Writing configurations to UAM

c) Click the [Yes] button to continue with the writing process

d) A window (Figure 7-51) displaying the UAM and user identification is displayed.

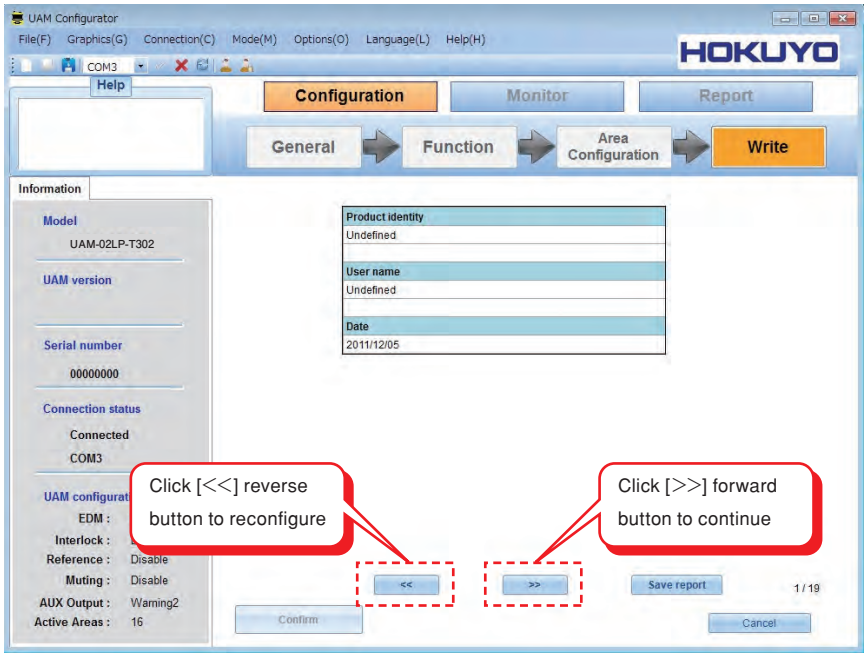


Figure 7-51. Configuration setting confirmation window

e) Please verify the displayed settings are correctly configured. Click the [<<] reverse button to return to the previous window. If settings are correctly configured, click the [>>] forward button to continue.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

f) After the forward button is clicked, a window displaying the configurations of EDM, Interlock and Reference Monitor are as shown in figure 7-52.

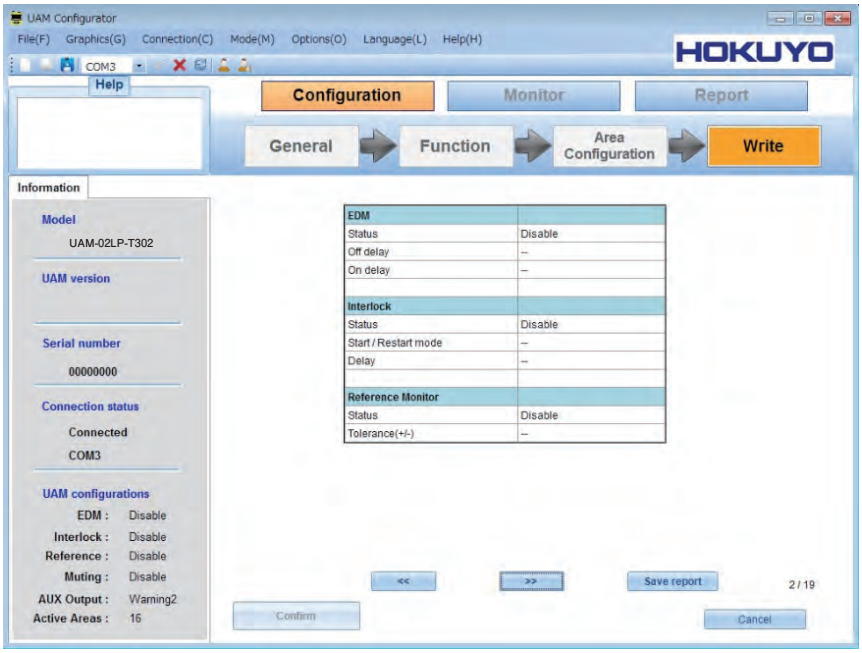


Figure 7-52. Functions configured

g) After the forward button is clicked, a window displaying the configurations of Muting, AUX Output, Minimum detection width and Active areas are as shown in figure 7-53.

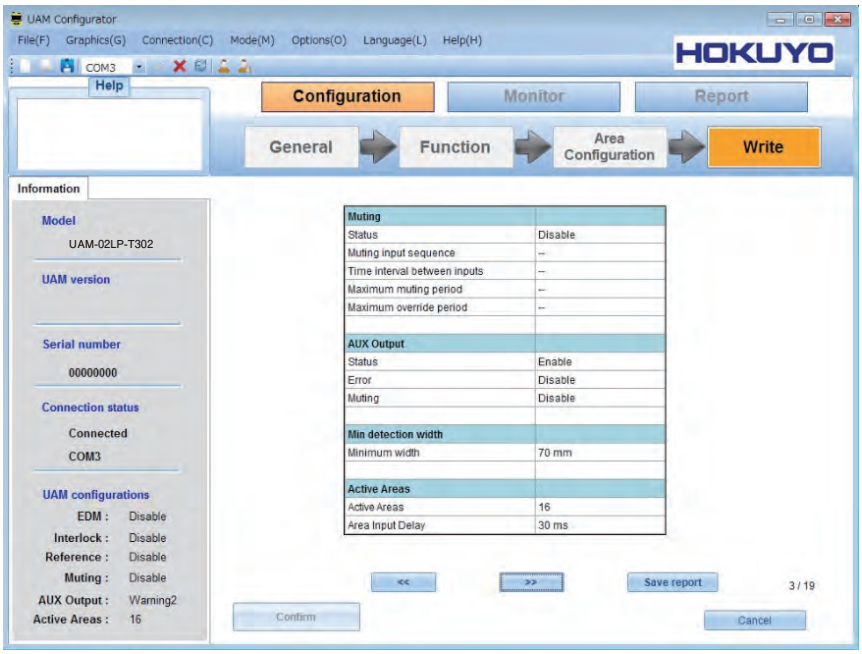


Figure 7-53. Functions configured

h) A window displaying all the configured areas as shown in figure 7-54 will be displayed. Please check all the configured areas by clicking the forward button. Click [Confirm] if all the areas are correctly configured. The [Confirm] button will be activated after all the areas are verified by user.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

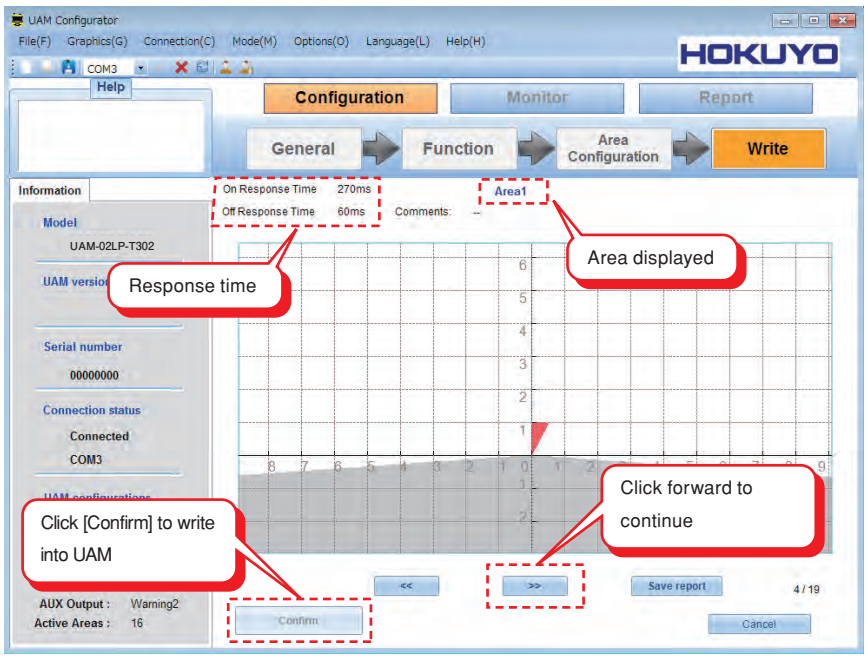


Figure 7-54. Area confirmation window

i) Once the writing process is completed, the main window will be displayed. User can check the configurations that were written into the UAM by selecting the [Read settings from device].

7.17 Save Project

UAM configurations are saved at once by performing the following steps.

a) Click [File] from the menu bar.

b) Click [Save project].

c) Enter a file name and click [Save]. Change the location of the file is necessary.

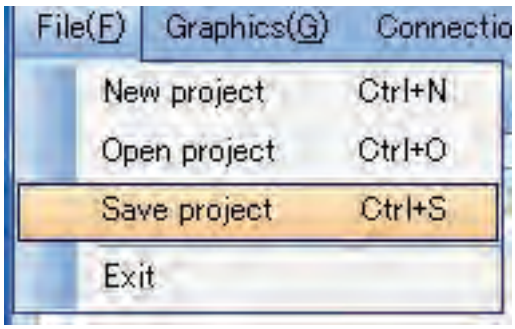


Figure 7-55. Save Project

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.18 Read configurations from UAM

User can check the current settings or confirm the configurations of the UAM by performing the following steps.

a) Make sure the connection between UAM and PC is connected.

b) Select the [Read configurations from the UAM] on the main window

c) Click the [OK] button.

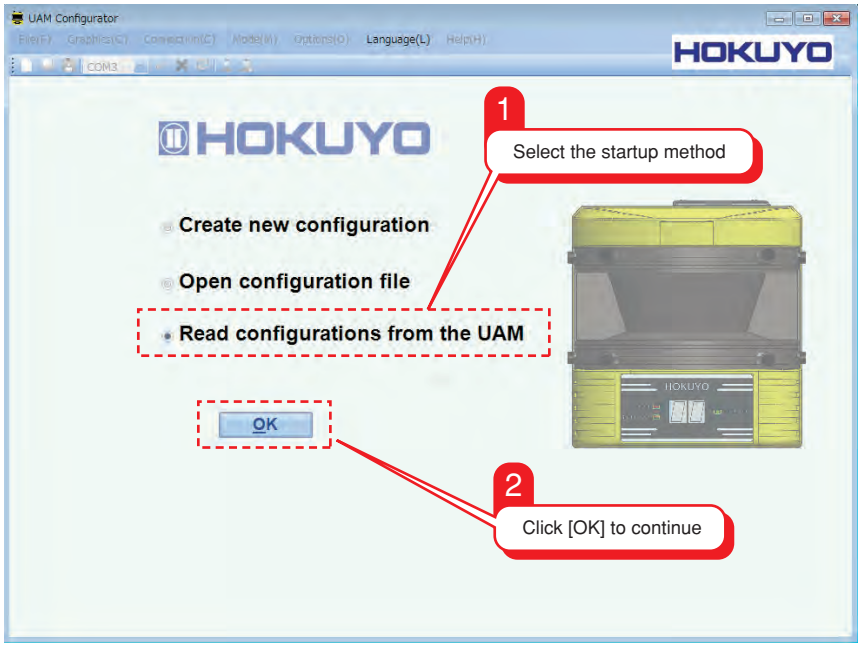


Figure 7-56. Reading settings from device

d) When reading process is in progress, the window as shown in figure 7-57 will be displayed.

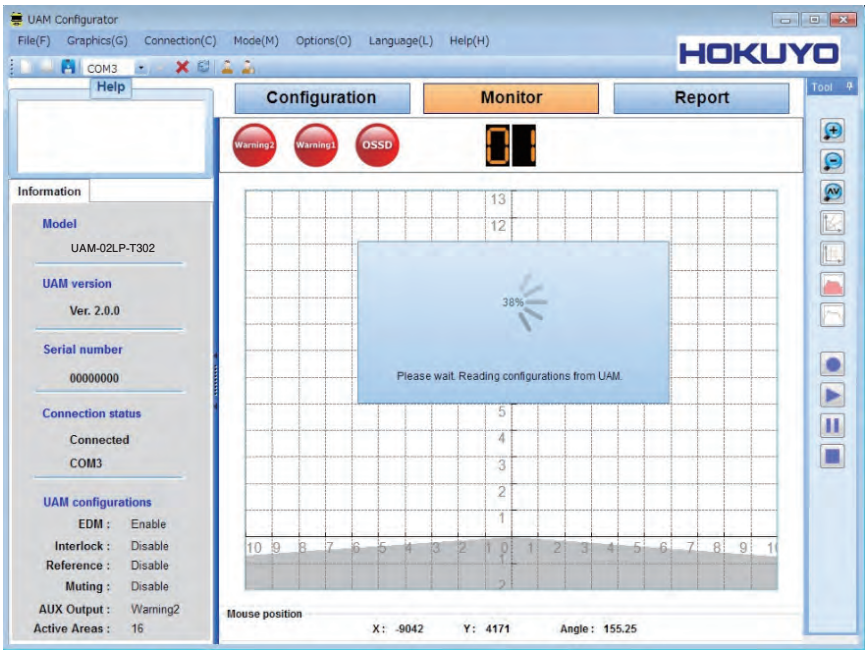


Figure 7-57. Reading configurations in progress

e) Once the reading process is complete, configurations are displayed in the Configurator.

If user would like to save the configurations, follow the steps described in chapter 7.17.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

7.19 Open Project

User can write the project into the UAM by performing the following steps.

a) Click [File] from the menu bar.

b) Click [Open Project]

c) A window will be shown, select the project file [*****.huc]

d) UAM configurations and areas will be shown.

e) Click [>>] to confirm the UAM configurations and areas.

f) Write the project into the UAM as described in chapter 7.16.6.

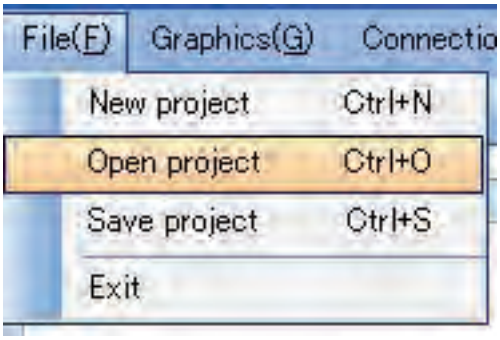


Figure 7-58. Open Project

7.20 Data logging

Range data can be recorded using the UAM Configurator. Follow the steps below for data recording.

a) Ensure the connection between PC and UAM is established

b) Start data recording by clicking the [Data logging] button.

c) A window is displayed requesting for the scan number and saving location as shown in figure 7-59. The scan number allowed is limited between 10 to 250 scans.

d) Use the [Browse] button to select the location for the saved data.

e) Click [Save] to proceed with the data recording.

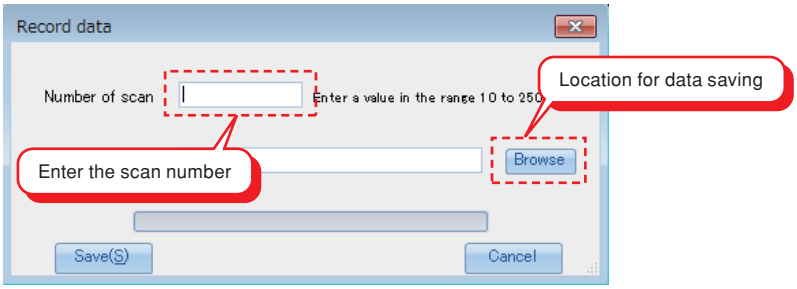


Figure 7-59. Data logging

f) To play the recorded data, click the [Play] button, select the recorded data, file. Recorded data will be played automatically once the file is selected. [Replay log] is displayed when the recorded data is displayed as shown in figure 7-60.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

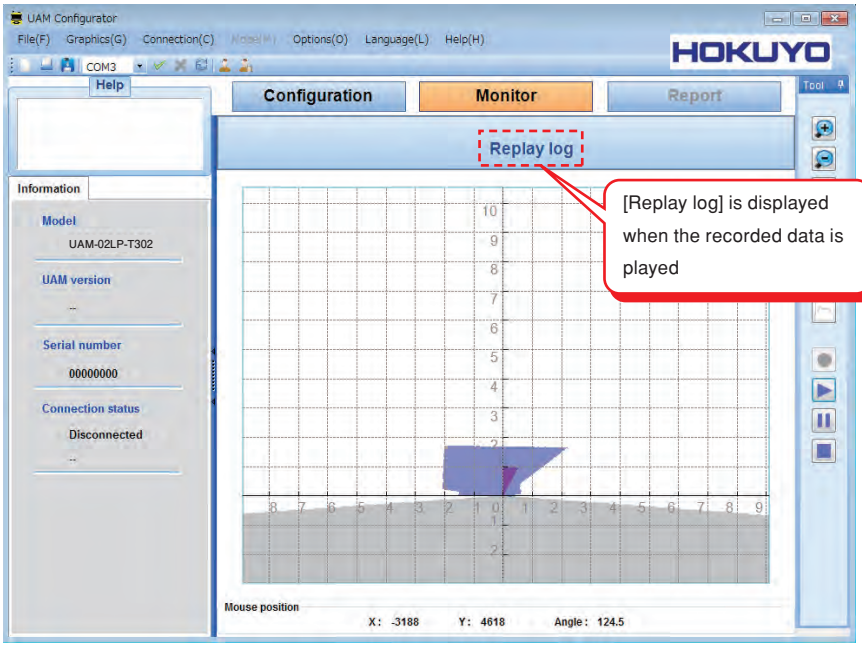


Figure 7-60. Replay log

g) Click [Pause] ❚❚ or [Stop] ■ button to interrupt the playing of recorded data.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

8. Inspection and maintenance

Inspection and maintenance are necessary for safety operation. User must ensure the inspection and maintenance are carried out as specified.

Before performing inspection and maintenance, user must ensure:

i) The machine or vehicle monitored by UAM is switched OFF

ii) The working surrounding is safe

Danger

- Do not modify or dissemble the UAM during inspection as this will affect the detection capability of the UAM leading to critical injury or death.

Caution

- Inspection and maintenance steps suggested in this manual are only basic steps. Operator should perform additional inspection and maintenance measures if necessary.
- Operator should follow necessary steps in accordance to the working environment.
- All the inspection should be perform during first commission of the UAM.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

8.1 Pre-operation inspection

Authorized personnel (with password) should perform pre-operation inspection after the configuration. The inspections should be conducted using test piece. User should perform this inspection without connecting to the machine or vehicle.

Table 8-1. Example pre-operation inspection list

No.	Check item	Condition		Remark
		Yes	No	
1	UAM is correctly mounted at the intended location and screws are firmly fastened.			
2	All the wirings are correctly connected.			
3	The OSSD signal switches from ON-state to OFF-state when the test piece is placed in the protection zone.			
4	The OSSD signal remains in OFF-state when the test piece is moved inside the protection zone.			
5	The OSSD signal switches from OFF-state to ON-state when the test piece is removed from the protection zone.			
6	Area is switched and the 7-seg LED is correctly displayed when the input signals are changed according to the area switching table.			
7	If the UAM is in automatic restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and switches from OFF-state to ON-state when the test piece is removed.			
8	If the UAM is in manual restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and remains in OFF-state when the test piece is removed.			
9	If the Start interlock is configured, without placing the test piece in protection zone, the OSSD signal will remain in OFF-state until the RESET signal is received.			
10	If the muting function is configured, UAM does not go into muted state (OSSD in OFF-state) although the start condition is fulfilled when test piece is placed in a protection zone not covered by muting area.			
11	If the muting function is configured, UAM does not switch to muted state when the muting input sequence is different from the start conditions.			
12	If the muting function is configured, UAM does not switch to muted state when the time interval between two muting inputs exceeded from the specified time interval.			
13	If the muting function is configured, the override function is terminated when the override period exceeded the specified override period.			
14	If the reference boundary function is configured, displacement of the reference boundary structures or UAM should cause the OSSD state switch to OFF-state when the displacement exceeded the allowable tolerance. This is applicable especially the angle of approach exceed ± 30° to the detection plane.			
15	If area sequence function is selected, OSSD switches to OFF-state when area is swithed to undefined sequence.			

Note: Stop using the UAM when any of the check item is marked "NO".

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

8.2 Operation inspection

This test should be conducted when the pre-operation inspection is completed. This operation inspection must be conducted with sufficient safety measures being taken. Performing this operation inspection before the pre-operation inspection could cause damage to the machine or device, serious critical injury or death.

Table 8-2. Example of operation inspection list

No.	Check item	Condition		Remark
		Yes	No	
1	The OSSD signal switches from ON-state to OFF-state and the machine or vehicle stop when the test piece is placed in the protection zone.			
2	The OSSD signal remains in OFF-state and the machine or vehicle stop when the test piece is moved inside the protection zone especially at the border.			
3	If the UAM in manual restart mode, OSSD signal switches from ON-state to OFF-state and the machine or vehicle stop when the test piece is placed inside the protection zone and remains in OFF-state when the test piece is removed.			
4	If the UAM in manual start mode, OSSD remains in OFF-state when UAM is restarted.			
5	If the UAM is in automatic restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and switches from OFF-state to ON-state when the test piece is removed.			
6	If the UAM is in automatic restart mode, OSSD remains in OFF-state when UAM is restarted with obstacle present in protection zone.			
7	If the Start interlock is configured, without placing the test piece in protection zone, the OSSD signal will remain in OFF-state until the RESET signal is received.			
8	If the muting function is configured, UAM does not go into muted state (OSSD in OFF-state) although the start condition is fulfilled when test piece is placed in a protection zone not covered muting area.			
9	If the muting function is configured, UAM does not switch to muted state when the muting input sequence is different from the start conditions.			
10	If the muting function is configured, UAM does not switch to muted state when the time interval between two muting inputs exceeded from the specified time interval.			
11	If the muting function is configured, the override function is terminated when the override period exceeded the specified override period.			
12	If the reference boundary function is configured, displacement of the reference boundary structures or UAM should cause the OSSD state switch to OFF-state when the displacement exceeded the allowable tolerance. This is applicable especially the angle of approach exceed ± 30° to the detection plane.			
13	If area sequence function is selected, OSSD switches to OFF-state when area is swithed to undefined sequence.			

Note: Stop using the UAM when any of the check item is marked "NO".

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

8.3 Daily inspection

Table 8-3 below shows the example of items that should be check during the daily inspection.

Table 8-3. Example daily inspection list

No.	Check item	Condition		Remark
		Yes	No	
1	The OSSD signal switches from ON-state to OFF-state when the test piece is placed in the protection zone.			
2	The OSSD signal remains in OFF-state when the test piece is moved inside the protection zone.			
3	Remove the test piece away from the configured protection zone and the OSSD signal should switch from OFF-state to ON-state.			
4	If the UAM is in automatic restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and switches from OFF-state to ON-state when the test piece is removed.			
5	If the UAM is in manual restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and remains in OFF-state when the test piece is removed.			
6	If the Start interlock is configured, without placing the test piece in protection zone, the OSSD signal will remain in OFF-state until the RESET signal is received.			
7	If the muting function is configured, UAM does not go into muted state (OSSD in OFF-state) although the start condition is fulfilled when test piece is placed in a protection zone not covered by muting area.			
8	If the muting function is configured, UAM does not switch to muted state when the muting input sequence is different from the start conditions.			
9	If the muting function is configured, UAM does not switch to muted state when the time interval between two muting inputs exceeded from the specified time interval.			
10	If the muting function is configured, the override function is terminated when the override period exceeded the specified override period.			
11	If the reference boundary function is configured, displacement of the reference boundary structures or UAM should cause the OSSD state switch to OFF-state when the displacement exceeded the allowable tolerance. This is applicable especially the angle of approach exceed ± 30° to the detection plane.			
12	If area sequence function is selected, OSSD switches to OFF-state when area is swithed to undefined sequence.			

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

8.4 Periodical inspection

Periodical inspection should be carried out to ensure the detection capability of the UAM. Table 8-4 below shows a list of the periodical inspection items. It is recommended to perform this inspection in a period of 6 months .This inspection should be performed together with the daily inspection.

Table 8-4. Example of periodical inspection list

No.	Check item	Condition		Remark
		Yes	No	
1	Screw is tightly fastened.			
2	No displacement from the original mounting position			
3	No scratch or crack on the optical window			
4	Screw of the optical window is tightly fastened			
5	No oil spot/content on the optical window			
6	No visible damage on the UAM			
7	Cable connector is in good form and tightly fastened.			
8	Area is switched and the 7-seg LED is correctly displayed when the input signals are changed according to the area switching table.			
9	The OSSD signal switches from ON-state to OFF-state when the test piece is placed in the protection zone.			
10	The OSSD signal remains in OFF-state when the test piece is moved inside the protection zone.			
11	Remove the test piece away from the configured protection zone and the OSSD signal should switch from OFF-state to ON-state.			
12	If the UAM is in automatic restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and switches from OFF-state to ON-state when the test piece is removed.			
13	If the UAM is in manual restart mode, OSSD signal switches from ON-state to OFF-state when the test piece is placed inside the protection zone and remains in OFF-state when the test piece is removed			
14	If the Start interlock is configured, without placing the test piece in protection zone, the OSSD signal will remain in OFF-state until the RESET signal is received.			
15	If the muting function is configured, UAM does not go into muted state (OSSD in OFF-state) although the start condition is fulfilled when test piece is placed in a protection zone not covered by muting area.			
16	If the muting function is configured, UAM does not switch to muted state when the muting input sequence is different from the start conditions.			
17	If the muting function is configured, UAM does not switch to muted state when the time interval between two muting inputs exceeded from the specified time interval.			
18	If the muting function is configured, the override function is terminated when the override period exceeded the specified override period.			

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

19	If the muting function is configured, the muting is terminated when muting period exceeds the specified maximum muting period.			
20	If the reference boundary function is configured, displacement of the reference boundary structures or UAM should cause the OSSD state switch to OFF-state when the displacement exceeded the allowable tolerance. This is applicable especially when the angle of approach exceed ± 30° to the detection plane.			
21	Safety-relay life-span is still valid			
22	If area sequence function is selected, OSSD switches to OFF-state when area is swithed to undefined sequence.			

Note ● It is strongly recommended to keep the maintenance record for traceability purpose.

8.5 Cleaning the optical window

Dust covering the optical window affects the detection capability of the UAM. Regular cleaning of the optical window is necessary especially when the UAM is mounted in a dusty working environment.

i) Wipe the optical window with a clean soft cloth

ii) Clean the optical window with a soft brush

iii) Blow off the dust on optical window using air-blower

iv) Clean the optical window with mild detergent if its contaminated with oil/grease particles

Danger
- Disconnect the system when cleaning the optical window.
- Failing to comply with this could lead to serious damage on machine, critical injury and death

Note ● Contamination on the optical window switches OSSD signal to OFF-state.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

9. Troubleshooting

This chapter describes troubleshooting methods while operating the UAM. Table 9-1 below shows the troubleshooting list.

Table 9-1. Troubleshooting list

Situation	Possible reason	Solution suggestion
UAM is not operating	Power supply is OFF/ Overvoltage/ Undervoltage	Make sure the power supply is ON
		Voltage is within the specification
		Power supply cable is in good condition
	Cable is damage	Replace with a new cable
	UAM configuration is incomplete	Reconfigure the UAM
UAM is not connected with the UAM Configurator	PC trouble	Check the PC' s specifications. Make sure the specification is compatible
		Close other unrelated application programs
	Power supply is OFF	Make sure the power supply is ON
		Voltage is within the specification
		Power supply cable is in good condition
	USB cable is not connected to the USB port	Make sure the USB connector is plugged to both the PC and UAM
Measurement data is not displayed	Power supply is OFF	Make sure the power supply is ON
	UAM is in error/lockout state	Voltage is within the specification
		Power supply cable is in good condition
		Check the error number displayed on UAM Configurator software or 7-seg display. Resolve the cause and restart the UAM
OSSD remain OFF even protection zone is free from obstacle	Light interference	Mount the UAM at a location that is free from light interference. Refer to section "5.1 Light interference" for countermeasures
	Mutual interference	Remount the UAM away from the detection plane of the other UAM. Refer to "5.2 Mutual interference" for countermeasures
	Contaminated optical window	Check for any contamination or damage on the optical window
	Floor is detected	Remount the UAM and make sure the detection plane is not towards the floor. User can also reconfigure the protection zone by excluding the floor
	Boundary is detected	Ensure the boundary is not within the protection zone. Reconfigure the protection zone
	Lockout state due to self-diagnostic function	Check the description of the error number and perform the possible solution as suggested
	UAM is interlocked	Check the configuration of the interlock. If RESET_ REQ is ON, supply UAM with RESET signal

Table 9-2 shows the error number of the UAM. These error numbers' information is displayed on the LEDs and 7-segment display of the UAM. If the UAM is unable to resume normal operation, please contact the nearest distributor or sales representative for support.

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

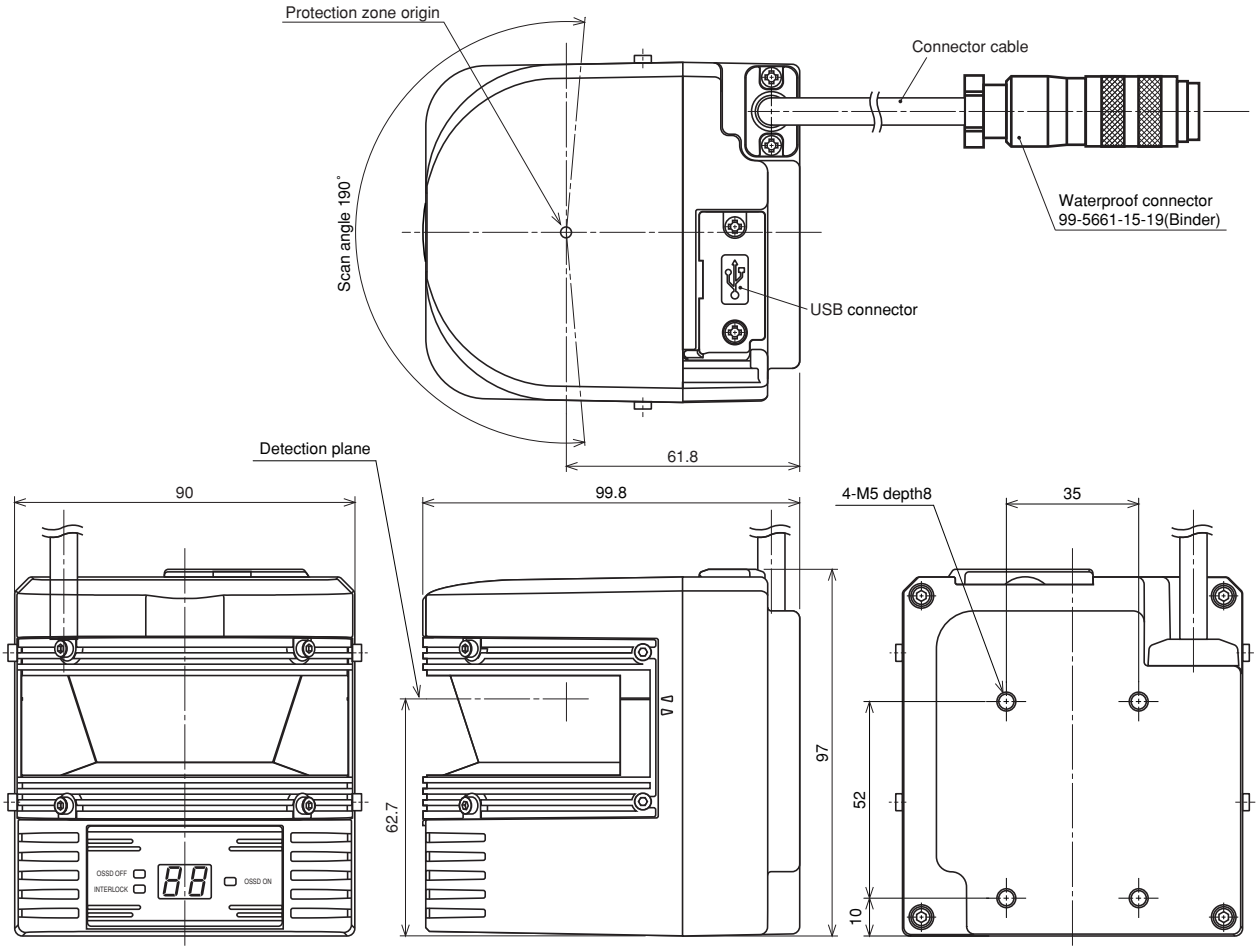
Table 9-2. Error number list

Error Number	Details
26	Setting error/Incomplete setting
31	
33	
48	Invalid area
49	Area Input Connection Error
4A	Area sequence error
66	Optical interference/High reflective background
6D	Power supply error
7B	Optical window contamination
7C	Object in limited detection zone
7E	Optical interference
98	OSSD monitor error
99	
9A	
9B	
9C	
9D	
B6	EDM input connection error
C0	Reset input error
C1	Reference monitor error
E9	Setting error/Incomplete setting
EB	
EC	
ED	
EE	
EF	
F0	
F1	
F2	
F3	
F4	
F5	
F6	
F7	
F8	
F9	
FA	
FB	Setting error/ Incomplete setting
** (Error other than above)	Device Error * = 0、1、2、3、4、5、6、7、8、9、A、b、C、d、E、F

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

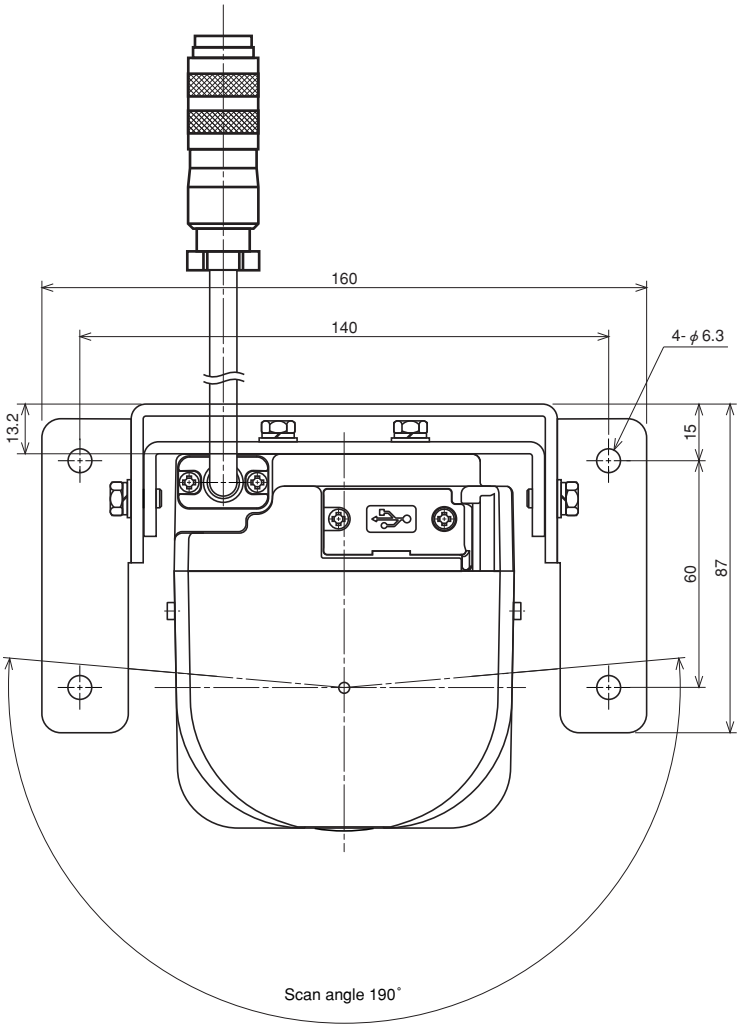
10. Dimensions

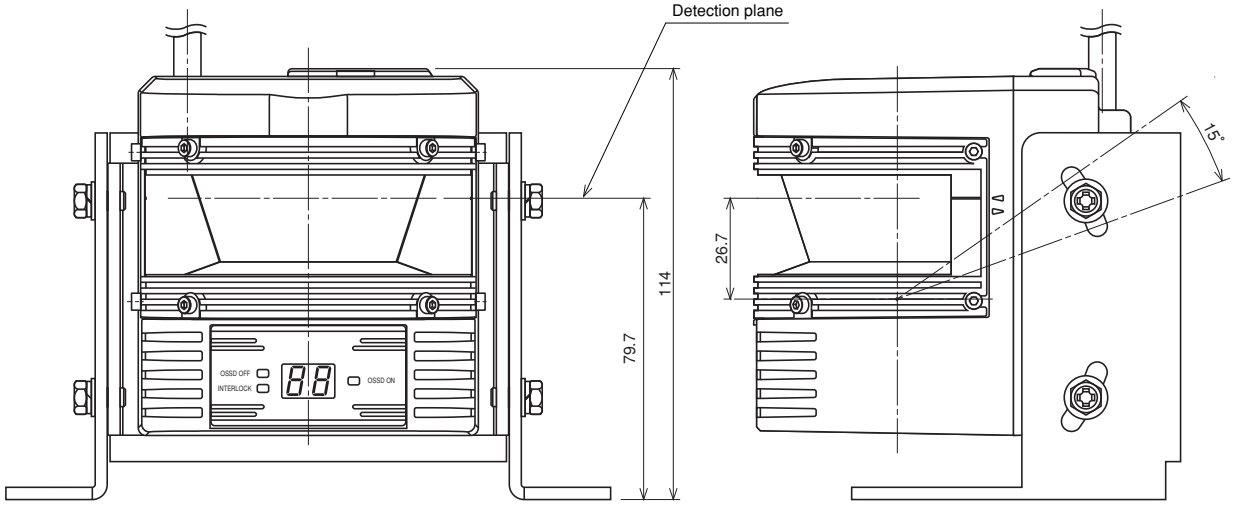
10.1 UAM-02LP-T302



HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

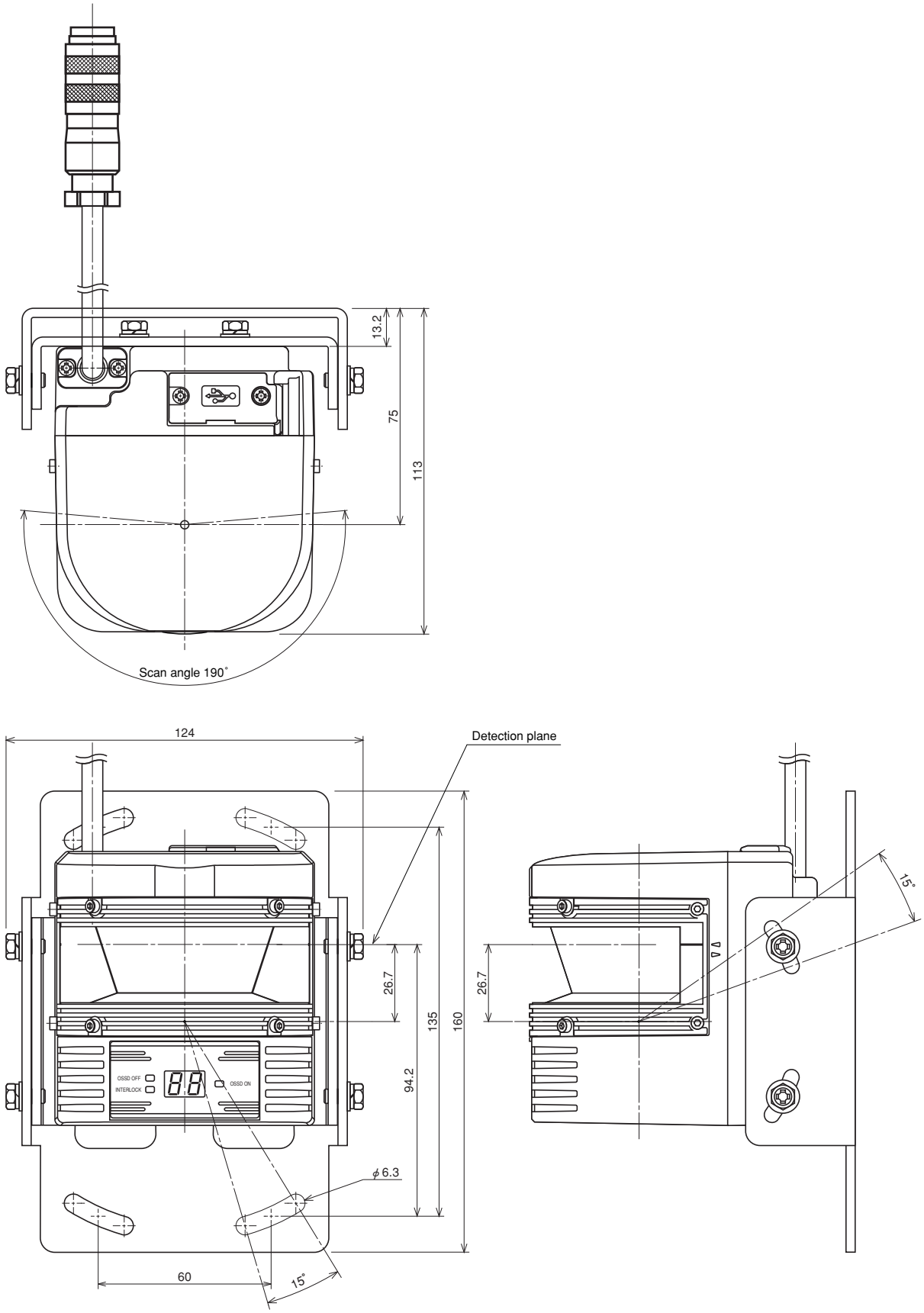
10.2 L-shape mounting bracket





HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

10.3 Vertical mounting bracket



HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

11. Revision history

Revision Symbol	Revision Date	Details
A	January 2013	First Release

HOKUYO AUTOMATIC CO.,LTD. All Rights Reserved

12. Representative contacts

● Asia and others

Hokuyo Automatic Co., Ltd

Osaka HU building, 2-2-5 Tokiwamachi, Chuo-ku, Osaka, 540-0028 Japan

Tel: +81-6-6947-6333

Fax: +81-6-6947-6350

E-mail: foreign-trade@hokuyo-aut.co.jp

URL: http://www.hokuyo-aut.jp

● Europe

Sentek Solutions Ltd.

1010 Cambourne Business Park, Cambridge CB23 6DP, UK.

Tel: +44 1223 923 930

Fax: +44 1223 923 940

E-mail: info@sentekeurope.com

URL: http://www.sentekeurope.com

● North America

Sentek Solutions,Inc.

2019 Van Buren Avenue, Suite A, Indian Trail, NC 28079, USA

Tel: +1-704-882-3844

Fax: +1-704-628-0582

E-mail: sales@senteksolutions.com

URL: http://www.senteksolutions.com

★ The contents described in this document are based on the information as of January 2013. The external dimensions, specifications etc. are subject to change without notice.

HOKUYO AUTOMATIC CO.,LTD.

Osaka HU Building, 2-2-5 Tokiwamachi, Chuo-Ku, Osaka, 540-0028 Japan
TEL: +81-6-6947-6333 FAX: +81-6-6947-6350
URL: http://www.hokuyo-aut.jp
E-mail: foreign-trade@hokuyo-aut.co.jp

13. 1. H